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Alexander III. Sissoi Veliky. Osliabia. Nakhimoff. Flagship Kniaz Suvaroff. Svietlana. Dmitri Donskoi. Isumrud. Borodino. Navarin. Monomakh.

RUSSIAN WARSHIPS DESTROYED IN THE BATTLE OF THE SEA OF JAPAN.—[See page 463.]

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NEW YORK, SATURDAY, JUNE 10, 1905.

The Editor is always glad to receive for examination illustrated articles on subjects of timely interest. If the photographs are *sharp*, the articles *short*, and the facts *authentic*, the contributions will receive special attention. Accepted articles will be paid for at regular space rates.

AN UNPARALLELED VICTORY.

When Japan boldly threw down the gauntlet to Russia, the world wondered at her daring; Russia was the "Colossus of the North"; Japan, the youngest of the nations to be born into our modern civilization, had not yet reached the dignity even of comparison with the mighty Muscovite empire. By sea and by land Russia overtopped Japan on every point of comparison. Hers was the third most powerful navy of the world, with half a million tons of fighting ships to command, and the unlimited resources of the empire to back it. Japan's little navy, on the other hand, had but just graduated into recognition. Although the foretaste which she had given of her quality in the Chinese war led us to expect that Japan would make a creditable effort, the best that we expected from her was that she would ultimately go down to defeat, everything lost but the honor of having fought a brave but hopeless campaign.

So the world thought and spoke, as the curtain was being rung up for the opening scene of the naval war. To-day, after eighteen months of the fiercest and most bloody fighting of modern times, the curtain has been run down upon the final act. In that brief interval, we have seen the third greatest navy of the world literally and absolutely swept out of existence, and this by a modest little navy that finds itself at the close of the war as strong in material and stronger in efficiency than at its beginning.

If Japan had won out with the loss of half her fleets, and the battered remnants had limped home in a condition of absolute exhaustion, it would have been a feat equaled but not surpassed in naval history.

But that she should have absolutely annihilated, in pitched battles upon the high seas, two successive fleets of the enemy, and have sunk, driven ashore, or otherwise put out of action fourteen battleships, twelve other armored vessels, and a dozen protected cruisers, without any diminution of her own fighting strength, is a feat for which naval history can find no parallel. That her navy is intact cannot be disputed; for her captures and new construction during the war about offset her losses.

Wherein are we to look for an explanation? Certainly not to any disparity in the materials of war, for the ships, engines, guns, and armor of the Russian navy were the best that the leading shipyards and gun factories of Europe and America could turn out. Nor was the distance of the seat of war from Russia's home ports so serious a handicap as might be supposed; for at no time did Japan make any serious effort to prevent the sending of re-enforcements and supplies. In the case of the Baltic fleet, she evidently encouraged its advance, feeling assured that every ship that entered the immediate zone of war was one ship lost to Russia.

Nor can the result be set down to cowardice. The Russian is no coward. He gives place to none in his ability to fight a losing battle to the bitter end. This was abundantly proved in the battle of the Sea of Japan; for the stories of the eye witnesses on both sides agree that the Russians fought with the grim energy of despair.

The explanation of the result is to be found first and last in the Japanese people themselves—in certain excellent traits of their character, many of which are due to a system of ethics that is older than our western civilization. Among these may be mentioned: Intense patriotism; self denial; scrupulous honor in all matters affecting the welfare of the State; a keen sense of duty; strict discipline; unquestioning obedience to authority; absolute unity of purpose; a firm belief in the destiny of their race; patience and endurance; an absence of self consciousness and posing, that may well put our "white" civilization to the blush; a close attention to detail; and lastly, a combination of great prudence and forethought with a marked ability to adapt themselves quickly to the circumstances of the hour.

It was a foregone conclusion that a people such as this, being naturally born to a seafaring life, would render a splendid account of themselves in the stress of a naval war. The ships were maintained in a high state of efficiency, and they were perfectly familiar to officers and men; the fleets were accustomed to maneuver in fighting formations; the marksmanship, judging from this last fight, was excellent; and lastly, the whole series of operations was controlled by an admiral who must be admitted to possess the highest qualities of his profession in the highest degree.

ELECTRICITY AS A STIMULANT TO PLANT GROWTH.

The flora of the north polar region is remarkable for rapid growth, fertility, and brilliancy of coloring, phenomena which seem incompatible with the climate. For the Arctic summer, though nightless, is very short, the sun is low, and its rays are often intercepted by fog and clouds, so that it cannot furnish an amount of light and heat favorable to very rapid growth.

The investigations of Prof. Lemstrom, of Helsingfors, and others, tend to show that electricity exerts a great influence on the growth of plants, and this view is confirmed by the luxuriant vegetation of the zone of action of that violent electrical manifestation, the aurora borealis. Furthermore, a close connection has been found, in Finland, between fruitfulness and frequency of auroras. Finally, Lemstrom was led to attribute to the sharp points of plants, such as the beard of grains, the function of "lightning rods," which collect atmospheric electricity and facilitate the exchange of the charges of the air and the ground.

Thereupon he proceeded to submit the suspected effect of electricity upon vegetable growth to the test of experiment, beginning in 1885 with a number of flower pots containing similar soil and seed. Some of the pots were subjected to the action of an influence or inductive statical electric machine, one pole of which was connected with the soil in the pot, and the other with a wire netting stretched over it. The other pots were left to nature. The electric machine was driven several hours daily. Within a week the electrified plants showed a more vigorous growth than the others, and in eight weeks the disparity in weight, of grain and straw alike, amounted to forty per cent. This favorable result suggested a field experiment with barley, in which an increase of 37 per cent was obtained by electrification. In the following year the experiments were extended to various plants. The results were contradictory in some respects, and showed that the advantage derivable from electroculture depends also upon other factors, such as temperature, moisture of air and soil, and the natural fertility and the manuring of the latter. The supply of water proved to be of especial importance. Extensive experiments with potatoes, carrots, and celery showed increases in crop of from 30 to 70 per cent. Potted strawberry plants, in the greenhouse, produced ripe fruit, under electrical influence, in half the usual time. Small differences, possibly due to extraneous causes, appeared when the direction of the current was reversed. Other field experiments gave increases of 45, 55, occasionally 85 per cent for grain, and 95 per cent for raspberries, while cabbage, tobacco, flax, turnips, and peas grew better without electrification than with it.

Then Lemstrom, in order to test the effect of climate on electro-culture, transferred his experiments from Finland to Burgundy, where he found his earlier observations confirmed, particularly in regard to the great influence of irrigation. He concluded that the more vigorous growth induced by electricity must be sustained by a rapid ingestion of food, that is to say—a rich soil being presupposed—by an abundant supply of water. With copious watering peas, which in the earlier experiments had reacted unfavorably to electrification, now showed a difference of 75 per cent in favor of the electrified plants, carrots gave an increase of 125 per cent, and sugar beets augmented their percentage of sugar by 15 per cent. The experiments in Burgundy also confirmed the importance of the character of the soil. The richer the soil, the greater is the advantage of electrical culture, which is quite useless in very poor ground. Hence, the Sahara cannot be converted into a garden by electro-culture.

In 1888 Lemstrom's experiments ceased for a time, but other investigators attacked the problem from a different side, endeavoring to affect by electrification, not the growing plant, but the seed. The Russian botanist, Spechniew, submitted grain to electrical action, and thought that it sprouted earlier and more vigorously than grain not so treated. Pautens, who in 1894 repeated Spechniew's experiments on a larger scale, came to the conclusion that electricity had no effect on dry seeds, but that it promised excellent results when applied in connection with moisture—which in itself promotes germination. The same conclusion was reached by Kermey, who in 1897 electrified grain strewn on moist sand in a glass cylinder through which it could be observed. The metal top and bottom of the cylinder were connected to the poles of a galvanic battery.

But while electrical treatment of dry grain is comparatively simple and cheap, electrification during germination is even more difficult and costly than the application of electroculture to the growing plant. Grandeau and Leclerq, therefore, returned to the latter method, but, instead of using an artificial source, they studied the effect of atmospheric electricity by covering part of a field with wire netting. The uncovered plants showed an increase of 50 or 60 per cent in growth and fruitfulness over the plants which were shielded by the netting from natural electrical action.

In 1898 Lemstrom resumed his experiments with the aid of an improved electrical machine and distributing apparatus. Again he observed remarkable increases of crop—with tobacco 40, potatoes 50, peas 56, sugar beets 40, carrots 37, grain 25 to 30 per cent. Spechniew and Bertholon obtained similar results.

As it is not practicable to cover fields with electrified nets, and as the influence of atmospheric electricity had been proved, Lagrange and Paulins have recently sought to increase the supply of the latter by setting among the plants galvanized iron rods to serve as conductors, and have thus obtained great increase in crops. This, as well as other methods of electroculture, is probably too expensive to be applied to ordinary field crops.

But in the cultivation of fruits and vegetables, particularly under glass, the economic conditions are very different. For, as electroculture promises not only greater, but also earlier crops, which command high prices, its introduction would secure to local gardeners large sums which now go to the South and would, at the same time, benefit consumers by reducing prices somewhat, though leaving them still remunerative. Floriculture offers another promising field for the application of electrical methods.

All this, however, belongs to the future. Much study and experiment and probably many failures must precede the general introduction of electroculture, though the results already obtained are certainly promising.

In what way is the growth of plants affected by electricity? Plants transform the energy of the sun's rays into chemical energy. Though the heat produced by the electric current may have some direct effect, especially in germination, the electrical energy supplied cannot, in general, replace or even greatly reinforce the energy of sunshine. It is rather to be regarded as a stimulus to metabolism and all the vital processes. One of these is the capillary elevation of water, which is promoted by a positive electric current flowing upward. This is one possible explanation of the promotion of growth by electricity, and though in some cases the best effect is obtained by directing the positive current downward, or in the opposite direction to the assumed principal flow of sap, these exceptions may mean that more food is supplied by the leaves than is commonly supposed. Another possibility is an increase in activity in both leaves and roots. The electrical influence on the flow of sap, however, appears to be proved by the fact that electroculture is beneficial only in connection with an abundant supply of water. According to Kermey, there is also an electrolysis of water within the plant, and further experiment may prove the existence of other electrical actions.

SOMETHING NEW ABOUT THE VOCAL MECHANISM.

To a recent issue of the British Medical Journal (No. 2308) Major R. F. E. Austin, of Imtarfa, Malta, contributed a very interesting paper on commonly overlooked factors in vocal mechanism, in which he asserts that the universal idea that all of us naturally possess either a good, bad, or indifferent voice is wrong, and contends that Nature is directly responsible for one, and one only, of these conditions and that the others must be attributed to man's unconscious departure from Nature's laws. It will be news to many that by far the greater number of us do not possess full control of the adductor muscles of the cords, and are therefore unable to place and keep the cords in the most appropriate position quickly. The author states that it is surprising what a number of professional voice users, as well as amateurs, fail in this respect. According to his thinking, the majority of voices are lost, not from overwork, but as a result of improper emission.

Major Austin contends that, in order to obtain quickly the thorough control of any muscles or set of muscles, they should be developed by brisk movements, which fully contract them. In the case of the adductor muscles of the cords, this can only be done by using the voice in a most inartistic although physiological manner. That is to say, words should be sung or spoken quickly in acute penetrating tones ("pat-a-wat-quack" being given as an excellent phrase for the purpose). The voice should be extended up and down, note by note, in this manner until the limits of the compass are reached. Classification into soprano, baritone, etc., should not be attempted before this has been done.

When the singer is able to obtain acute metallic

ringing notes in the whole of the compass with ease, the author says he should attempt to sustain the various vowels. In the first instance this can best be accomplished by prefixing "pat-a-wat" to them, thus: "pat-a-wat-way," "pat-a-wat-wee," "pat-a-wat-wy," "pat-a-wat-woh," etc. Afterward they must be practised by themselves, and when perfected, words, phrases, etc., should be tried in the whole of the compass. It should be noted that the vowel "Ah" must not be used until the voice is thoroughly under control. When this is so, Austin admits, there is no better vowel for practice, for it helps to give the open throat so very necessary for good voice production, but if used too early in the training, it tends to force the vocal cords apart.

In the above method no attention is paid to breathing, the whole of the mind being concentrated at first on getting a loud, sustained, metallic ringing tone. When the habit of contracting quickly and fully has, so to speak, been impressed upon the adductor muscles of the cords, gradations of tone can be carried out with safety and delightful ease, and it will be found that whatever amount of breathing is required for phrasing, etc., can now be taken in and scientifically dealt with without having to worry about breath control.

THE RAILWAY AROUND LAKE BAIKAL.

Lake Baikal has hitherto made a very troublesome break in the continuity of the great Siberian railway. This large sheet of water, one of the biggest lakes in the world, has had to be traversed by various means, according to the season of the year—by steam ferry, ice-breaker, and, when the ice was strong enough, by carriage; and finally, since the outbreak of war, by a railway laid on the ice. This line round the lake has been under contemplation from the outset, but the natural conditions of the country through which it had to pass offered a multitude of obstacles to the engineers, and several distinct plans have been under consideration. This should be taken as only applying to the section as far as Kultuk, beyond which place the direction of the line was decided upon as early as 1899, while the former section could not be taken in hand till 1901. The railway was not expected to be ready before the beginning of next year, but the work has progressed so fast since the beginning of the war that it is now practically complete. Although water supply and the full complement of sidings allow of fourteen trains per day in each direction, it was proposed to run only seven trains a day in each direction and to use the ferry, the arrangements for which have been improved, as a kind of auxiliary and reserve.

The line eventually chosen is the one proceeding from the station called Baikal to Kultuk, and from thence to what is now the town of Myssowek along the shore of Lake Baikal. Proposals were made in favor of an alternative line passing over the elevated country between Irkutsk and Kultuk, which at places rises more than 2,000 feet above the level of Lake Baikal, which is again some 2,000 feet above the sea. Among the reasons why this plan was discarded were the heavy gradients, in some places over 17 per cent; and the unfavorable quality of the rock. The total length of the shore line which was eventually chosen is 161 miles, while the calculated expenditure is $27,049,803, part of the aggregate expenditure including some works connected with the extension of the harbor at Tanchoi, which materially increase the capacity of the ferry traffic. The railway is thus the most expensive line ever built within the Russian empire, and the one which has presented the most serious engineering difficulties, its building necessitating a large number of special constructions, such as tunnels, bridges, viaducts, etc. The coast of Lake Baikal, from the mouth of the River Angara to Kultuk, a distance of about 530 miles, is very mountainous, the rocks in many places leaving but a narrow strip of foreshore, while in others they descend sheer into the lake, rising to a height of 1,000 feet above the level of the water. These mountains are, besides, in many places intersected by awkward crevices and clefts. On this section of the line there are no fewer than 32 tunnels, in addition to which there are 210 bridges, viaducts, special supports, etc. The railway, like a huge snake, crawls along the side or makes its way through the mountain in a variety of twists and bends, at one place having to cross an inlet of the lake. It has often been necessary to take special precautions against the falling upon the line of pieces of loose rock, as the mountains in this region have been much affected by volcanic eruptions. Water is apt to make its way into the tunnels from the same cause. The looseness of the rock in many places has also necessitated the bricking up of the tunnels to a far greater extent than was originally calculated. The amount of rock and earth work is enormous, the former even reaching the figure of 10,000 cubic saschen (70,000 cubic feet) per verst.

The other section of the new line, from Kultuk to Myssowek, runs over an entirely different kind of country and has in every respect been much easier to build, nor has there been any wavering as to its direction. Beyond Kultuk the mountains on the whole recede further from the shore, leaving ample flat land for the railway, which, on the whole of this section, only passes one tunnel. On the other hand, several large streams have to be crossed, necessitating the building of bridges up to 500 feet in length. The country is almost uninhabited, and the soil is always frozen; the mean temperature of the year is half a degree Centigrade of frost. The bridges are all built of stone and iron, as are the viaducts. The railway has the ordinary Russian gage and only one line of rails, but the tunnels are constructed wide enough for a double track. The traffic, under ordinary circumstances, is calculated to comprise seven trains daily in each direction, a number which, however, as already mentioned, can be doubled. The maximum gradient is 8 per cent (in the tunnels considerably less), and the smallest radius of curve is about 1,080 feet.

The whole of the railway round Lake Baikal has been built by contractors, and has not been split up in such small portions as was the trans-Baikal Railway, nor partly built by the government itself, as was also the case with portions of that line, and there is every reason to believe that it has been satisfactorily constructed.—London Times.

THE CURRENT SUPPLEMENT.

The current SUPPLEMENT, No. 1536, is opened with an excellent article by Emile Guarini on the new Jungfrau locomotive. The first installment of a good review by Sir William H. White on submarines is presented. How modern geodetic rules are corrected for expansion of metals is explained in a thorough article. The methods followed in the manufacture of ferro metals in general, and the result of four years' study of ferro-titanium in particular, are presented by Auguste J. Rossi. Dr. O. Schott writes on a new ultra-violet mercury lamp which is primarily intended for the production of therapeutic ultra-violet rays. The demands made upon locomotives in point of speed and tractive power have steadily increased. Still, their size and weight are limited. The efforts of locomotive builders have, therefore, long been directed toward increasing the efficiency of the steam and thus obtaining a greater power from a given boiler capacity. How German builders have used the superheater for this purpose is clearly explained in a well-illustrated article. The result of an investigation of the oscillations of railway vehicles is published. Mr. Cowper-Coles has recently made a series of experiments on the electrolytic piercing of metals. These experiments are described. One of the men who ran the 130-mile-an-hour Berlin-Zossen train was an American engineer, Mr. Charles A. Mudge. His critical tabulation of the results obtained in that famous run are of interest. Charles E. Benham describes a curious induction experiment. In the SUPPLEMENT of February 27, 1904, we presented a copiously illustrated paper on clock escapements. In the current SUPPLEMENT will be found a counterpart to this paper on watch escapements. The usual science notes, electrical notes, and engineering notes are also published.

A NEW STAR.

Harvard announces the apparent discovery of a new star, R. S. Ophiuchi. Miss Cannon, from an examination of the light curves, called attention to the remarkable increase in the light of this star which took place in 1898. The star has been photographed every year since 1888, except 1889. The star appears to have had about the tenth magnitude before 1891, gradually increasing in brightness from the year 1893 to 1897.

In 1898 it was somewhat fainter, until May 31, and one month later, on June 30, it was more than three magnitudes brighter. Then it gradually grew fainter, until October 8, when it was again at about the tenth magnitude. During 1899 it remained faint, but in 1900 became brighter, diminishing again to the tenth magnitude in September of that year.

Since then the variations have been slight. An examination of several good chart plates shows only one star in this position. Both spectrum and light curves indicate this object should be regarded as a new star rather than a variable star, and its proper designation would be Nova Ophiuchi No. 3. The new stars of 1604 and 1848 appeared in this same constellation.

METEOROLOGICAL SUMMARY, NEW YORK, N. Y., MAY, 1905.

Atmospheric pressure: Highest, 30.38; lowest, 29.65; mean, 29.99. Temperature: Highest, 80, date, 7th; lowest, 41, date, 2d; mean, 69.5; normal, 59.8; excess over mean of 35 years, + 0.7. Warmest mean temperature, 65, 1880. Coldest mean, 54, 1882. Absolute maximum and minimum for this month for 35 years, 95 and 34. Average daily temperature deficiency since January 1, — 0.8. Wind: Prevailing direction, South; total movement, 8,632 miles; average hourly velocity, 11.6 miles; maximum velocity, 48 miles per hour. Precipitation, 1.12. Average for 35 years, 3.11. Deficiency, — 1.99; since January 1, — 4.10. Greatest precipitation, 7.01, 1901; least, 0.33, 1903. Thunderstorms, 13th, 15th, 18th, 28th. Clear days, 9; partly cloudy, 14; cloudy, 8.

SCIENCE NOTES.

What is believed by antiquarians to be the oldest paper book in existence is the "Red Book of Lynn," an ancient register belonging to the Corporation of King's Lynn (England). This volume is known as the "Red Book" from its original binding having been of that color. The first entry is a transcript of the will of Peter de Thorndon, burgess of Lynn, dated 1309; the latest entry is on folio 100, and is dated 15 Richard II. Some fifty years ago it was repaired and rebound, and the leaves, which age had reduced to a loose, fibrous substance, were carefully resized as an aid to preservation.

Pursuing his studies on the presence of methyl aldehyde in smoke, in the course of which he has established the fact that it is found in all usual combustions, M. Trillat has communicated to the Académie des Sciences these conclusions: Formic aldehyde exists in the soot of our chimneys and in the air of cities. It is found in noticeable quantities in the combustion of sugar, juniper berries, sweet roots, benzoin; in particular, when the combustion occurs in contact with hot metallic surfaces, whose catalytic effect intervenes to increase the yield. The constant presence of formic aldehyde in the gaseous or solid part of fumes explains their disinfecting action, in which the good effects of formic aldehyde were utilized long before they were known or studied.

M. Leduc has presented to the Académie des Sciences the course and results of his experiments, and draws the following conclusions: (1) Muscular contraction raises the osmotic pressure in the muscle; (2) this elevation of the pressure may exceed 2.521 atmospheres, 2.604 kilogrammes per square meter of surface; (3) the elevation of the intramuscular pressure is the greater as the excitations are stronger and more prolonged; (4) the elevation of the osmotic pressure in a contracting muscle is, for the same excitations, the greater as the resistance met by the contraction is the greater; and (5) these considerable changes of the osmotic pressure in a contracting muscle necessarily exercise a preponderating, if not a unique influence, in causing fatigue.

Many astronomers have sought to photograph the solar corona when not totally eclipsed, but have not secured a satisfactory result. M. Hansky, in a communication to the Académie des Sciences, describes his success in operating at the summit of Mont Blanc, where in the rarity and purity of the atmosphere the red rays in the spectrum are feeble as compared with the yellow rays and the green. By combining colored lenses, suitably selected, employing plates very sensitive to the red, and profiting from these facts, (1) that the rays appertaining to the red part of the solar spectrum traverse an atmosphere without sensible absorption or dispersion, (2) that the continuous spectrum of the corona is very intense in its least refrangible part, and (3) that photographs render very sensitive the slight difference in luminous intensity of objects photographed, and that processes permit even of increasing these contrasts, he succeeded in photographing the corona of the sun in the red part of its spectrum. The photographs which he presented exhibited the solar corona with an intensity and perfection not hitherto attained, except during solar eclipses.

The results of the geological surveys that were carried out by Mr. H. H. Hayden, of the Geological Survey of India, who was attached to the recent British expedition to Lhasa, have been published. From his investigations the country is strikingly poor in minerals of economic value, the only one found *in situ* being gold, which is obtainable in very small quantities from the coarse gravel beds of the Tsangpo. The largest yield obtained by panning was only at the rate of 28 grains of gold per ton of gravel. Concentrates were found to contain, in addition to much magnetite and zircon, a small quantity of rutile and hercynite, and probably uraninite. During his sojourn at Lhasa the geologist purchased varied samples of the gem stones employed by the local jewelers, among them being turquoise, ruby, tourmaline, emerald, and sapphire. The jewelers stated that all these stones were brought from a considerable distance, some coming from Ladak and Mongolia, and others from India. Mr. Hayden could obtain no trustworthy information as to the existence of any native sources of gems, and concludes that turquoise is practically the only native gem stone. He also succeeded in disproving the general belief that coal is to be found at Lhasa.

The production of all kinds of rails in the United States in 1904 amounted to 2,284,711 gross tons, against 2,992,477 tons in 1903, a decrease of 707,766 tons, or 23.6 per cent. The production of Bessemer steel rails in 1904 amounted to 2,137,957 gross tons, against 2,946,756 tons in 1903, a decrease of 808,799 tons, or over 27.4 per cent.

A NEW APPARATUS FOR COALING STEAMERS.

The problem of rapidly coaling steamships is one that has always presented many difficulties to those who have attempted to solve it. If we neglect the time element the difficulty of filling the bunkers of ocean liners is materially lessened, but as the conditions of modern commerce demand speed above all, it has been the aim of inventors for years to design a successful high-speed coaling apparatus. In crowded harbors such as that of New York, where every inch of water front and pier space is invaluable, there is the added condition that the space occupied by the mechanism must be a minimum. There are types of coaling machines in use at the present time which can easily handle a hundred tons per hour, but they possess, as a rule, the great disadvantage of being too large and cumbersome. Most of them, built directly upon barges, carry their own coal, usually about four hundred tons, and when this has been transferred to the vessel the entire floating apparatus must necessarily be removed before that particular machine can be used for further coaling operations. Moreover, the size of the apparatus is such that it cannot be placed between the ship and the pier, its height preventing its passing under the gangways.

Feeding the Coal into the Buckets.

Within the last year, a new coaling apparatus, the invention of Mr. L. A. de Mayo, has made its appearance, an apparatus which seems to fill the requirements which have been indicated. In this invention Mr. de Mayo appears to have solved many of the difficulties, general and local, encountered in this problem. One of the fundamental advantages of the de Mayo system is its simplicity, and, as the illustrations show, an explanation of the mechanism is almost unnecessary. After severe and repeated trials the American Line has adopted the apparatus and is using it regularly at its North River piers. Other steamship companies are negotiating for its use, and the navy departments of several governments have displayed keen interest in the invention. Our own government has ordered two machines which are to be thoroughly tested by the navy.

The machine consists of a comparatively light, steel frame tower. Within this is an endless articulated steel belt carrying buckets made of the same material. The belt runs over sprockets at each end of the frame. Near the upper end of the tower between the rising and descending chains of buckets is an electric motor which drives a large spur wheel. The upper belt sprocket is driven from the shaft of the large spur wheel by means of a chain. The supply current for the motor is taken from the dynamos on board the ship, and its speed is regulated by a portable automatic-release starting-box. The weight of the entire machine of the type in use at present is about two tons; its dimensions are approximately 31 x 3 x 3½ feet. It has twenty-nine buckets, each of which is designed to hold a cubic foot or about fifty-six pounds of coal. A crew of six men is required per machine. The apparatus can be suspended by means of ordinary tackle from either side of a ship, or from the pier. Its weight keeps its lower end below the level of the surrounding coal pile, gradually lowering as this is decreased. It can readily be moved in the barge or on the pier by four men. The narrow harbor barges with open loads, carrying about 400 tons of coal, are very well adapted for the use of the apparatus, and thus all available dock space is left free for the handling of cargo.

When run at its highest rate of speed, the apparatus can deliver a hundred and eighty tons of coal per hour. At this rate, however, there is great difficulty in economically feeding the coal, and the usual rate of delivery is about a hundred tons per hour. This rate includes a generous allowance for time lost in moving the machines from bunker port to bunker port, and shifting from one barge to another. As a rule, three or four of the machines are used on each side of the ship. In case of necessity eight machines on each side could be placed, and in this case a vessel of the size of the St. Louis or St. Paul could easily be coaled in ten hours. In the old manner of coaling with steam-hoist buckets, seven men could handle fifteen tons of coal per hour. The advantage of the new system over the old is too apparent to need comment.

With the old system just mentioned, large quantities of coal were lost, falling overboard either when the buckets were hoisted, or while they were being emptied. In the de Mayo apparatus, the coal travels from the barge to the bunker entirely within inclosed passages, for though the illustrations show the machines as partially open, they are ordinarily enveloped in tight canvas jackets, only the lower extremity, where the coal is shoveled into the buckets, remaining uncovered. A further great advantage arising from this is the almost perfect elimination of the coal dust. The officers in charge of vessels that have used this apparatus are very enthusiastic over this advantage of the de Mayo system, for the clouds of coal dust incident to the period of taking in coal in the old way sadly interfered with the spick-and-span appearance of the ship.

Upper End of Framework, Showing Driving Motor and Gear.

Three of the Machines in Use, Showing Method of Suspending Them from the Vessel.

THE DE MAYO APPARATUS FOR COALING STEAMSHIPS.

Peat as a Paper-Making Material.

About two years ago in Scotland and Ireland there was a revival of interest in the utilization of peat as a material for making paper, book board, etc. The failure of many previous undertakings, large and small, did not deter capitalists from investing in new plants, two of which have been operating for some time. The principal product is wrapping paper. It cannot be said that the industry is as yet much beyond the experimental stage, nor that any very important results are promised.

The difficulties that beset the earlier experimenters have not been wholly overcome and are still serious drawbacks to the economical use of peat. They are: (1) The troublesome and expensive process of getting rid of dirt, requiring a large amount of soda in the boiling vats; (2) lack of sufficient fiber in peat, necessitating the addition of other material, such as old gunny bags, ropes, hemp, etc., to make paper that will serve the ordinary purposes of grocers, dry goods merchants, and other tradesmen, my information being that little of the peat paper now put on the market is more than 75 per cent peat; and (3) the apparent impossibility of bleaching the peat pulp to a satisfactory extent, which means practically that only brown paper can be produced.

In view of these obstacles and of the low cost of manufacturing paper from straw and wood pulp, German straw paper selling in this market at $31 per ton of 2,240 pounds, it is not a cause for surprise that the progress of the peat-paper industry has been slow. One merit claimed for peat paper may lead to its extensive use for certain purposes—the manufacturers say that it will not harbor moths.—Rufus Fleming, Consul.

Wherever you find machinery, there it is necessary to reckon with friction; it is a great dissipator of energy, and heat is produced. To the uninitiated the slight modifications in an alloy do not seem of enough importance to be noticed. Those who have made a careful study of alloys find that just this feature may work direful results. M. Bischoff states that he can detect the deteriorating effect of one part tin upon ten million parts of pure zinc. Mr. Thurston found half of a per cent of lead to reduce the strength of a good bronze nearly one-half, and to affect its ductility to an almost equal extent. The success of an anti-friction alloy depends largely upon the combination in suitable proportion of the metals, producing a well-balanced alloy. An anti-friction metal, which has proved an unqualified success and stood the most crucial tests in actual service, is worthy of careful study. One of the more recent of these alloys is called cosmos, and has proved to possess certain extraordinary qualities. This alloy not only reduces friction and lubrication, but it sustains, within reasonable limits, great pressure without undue abrasion or compression.

WHERE WAS THE CAMERA SET UP?

BY WILLIAM F. RIGGE, S. J.

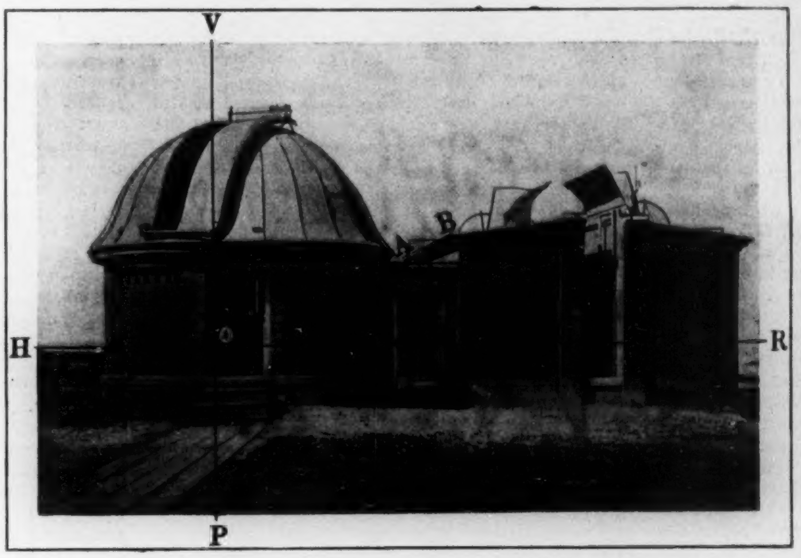
In a former issue of this journal (September 24, 1904) I solved the problem as to *when* this photograph of the Creighton University Observatory (at Omaha, Neb.) was taken. In the present one I wish to find *where* the photograph was taken from, that is, to determine the exact spot at which the camera was set up. The solution of this problem is much easier than that of the first, and that in practice as well as in theory.

There are in general, I might say, two methods of solving the present problem, the physical and the mathematical methods. The physical method would consist in walking toward or away from the building, and by a careful scrutiny of the view it presents to the eye, to find the spot from which this view is identical with that shown on the photograph. This method might be capable of giving very good results. But as its principles are not evident, there is nothing to be learned from it. Moreover, the solution it offers would become impossible, when this access to the building for some reason or other becomes impossible.

The mathematical method makes use of the principles of perspective, and obtains its results from a few simple measurements executed upon the building and upon the photograph. In case it should be impossible to obtain these measures from the building itself, its plans, elevations, or at least the necessary specifications, must be supposed to be obtainable. To explain this mathematical method is the purpose of the present article.

We begin our attack upon the problem by determining the position of the horizon line, *H R*, upon the photograph, that is, of the line which is on a level with the camera. As the equatorial room of the Observatory is circular in shape, each horizontal row of bricks and each mortar line is in reality a circle. But as the eye, or the camera, can be on a level with, or in the plane of, only one of them, this one alone must appear on the photograph as a straight line, while all the rest must appear to be more or less curved. For this reason the horizon line, *H R*, must not only run perfectly straight through a row of bricks or a mortar line across the whole building and across all buildings, whatsoever their shapes may be, shown on the same photograph, but it is also the only line that can be so drawn. In our case this horizon line runs through the middle of the seventh row of bricks above the water table of the equatorial room. Measurement upon the building then shows that the camera was 18⅞ inches above the level of this floor.

By the principles of perspective, all lines parallel to one another in space will meet, if produced upon the photograph, at a certain definite point, called the vanishing point. If the lines are horizontal, this point must be on the horizon line, *H R*. As we wish to find the distance the camera was set up in front, or south, as well as east or west, of the building, we select the horizontal lines running north and south. Unfortunately, the present photograph has only one such line to offer, but that one is well defined, and it is amply sufficient for the purpose. This is the line *A B*, the west edge of the roof of the transit room, the edges of the transit shutters not being judged sufficiently reliable for the present determination. We produce the image of the line *A B* on the photograph until it intersects the horizon line, *H R*, in the vanishing point, *O*, through which the vertical line, *V P*, may then be drawn. It is plain that the line drawn from the camera to the point, *O*, is also horizontal and due north and south and projected into the point, *O*, itself. Hence, if we measure the distance of the point, *O*, almost at the very edge of the door frame, from the middle of the door, which is due south of the center of the equatorial room, we can determine how far the camera was set up west of the center of the dome. This measurement may be executed either upon the door itself or upon its image on the photograph, since we know that here the scale gives us 18⅞ inches as the distance from the horizon line, *H R*, to the water table of the building. The result is that the camera was set up 15¼ inches west of the center of the dome. This is therefore our second co-ordinate.



WHERE DID THE PHOTOGRAPHER STAND WHO TOOK THIS PICTURE?

The next part of the problem is to determine the distance of the camera from the front of the building. Let us imagine a plane drawn in space through the edge of the roof, *A B*, and the point, *O*. This will give us Fig. 2. *D* is the camera, that is, the optical center of its lens. *O* and *B* are the corresponding points *O* and *B* on the photograph. *C* is the true place in space of the point, *A*, that is, of the north end of the edge of the roof, and *A* is its apparent place as seen on the photograph. The plane of the photograph is perpendicular to the line *O D* at the point, *O*, and hence *O D* is the distance due south of the optical center of the lens from the south end of the edge of the roof, *B*.

How the Distance of the Camera from the Front of the Building was Determined.

In Fig. 2 we have two similar triangles, *A O D* and *A B C*, and hence the proportion:

$$\frac{AO}{AB} = \frac{OD}{CB}, \text{ whence } OD = \frac{AO}{AB}\,CB.$$

As the ratio $\frac{AO}{AB}$ is the same on the photograph as it is on the building, the problem is thus very much simplified in practice, since all we need for its solution are the length of *C B* measured on the roof, and the lengths of *A O* and *A B* measured on the photograph on any scale whatever. The edge of the roof, *C B*, was found to be 17 feet 10⅛ inches, and *A O* and *A B* on the photograph were found to be 11.31 and 2.96 respectively on a scale of fifths of an inch. Hence by proportion *O D* is equal to 68 feet 2¼ inches. As the cornice overhangs 7⅝ inches, the distance of the optical center of the lens from the south front of the transit room was 68 feet 10 inches. By additional measurement we find that the camera was set up 72 feet 7 inches south of the center of the dome, which is the third co-ordinate, or 64 ft. 7 in. south of front door.

We can now also find the focal length of the lens. Knowing that twenty-five bricks at the front door measure 72¼ inches in reality and 1¼ inches on the photograph, we see that the photograph reduced the size of this object 57.8 times. Then on Fig. 2, where the triangle, *D E F*, has been enlarged ten times, we have a proportion similar to $\frac{AO}{EF} = \frac{OD}{DE}$, that is, we divide the distance of the camera by 57.8, and get $ED = 13.47$ inches as the effective focal length of the camera for this photograph. Erecting a perpendicular 13.47 inches long to the plane of the original photograph at the point, *O*, we are in a condition to reconstruct the whole observatory in all its three dimensions.

The solution presented in this article supposes that the plane of the photograph, the picture plane as it is called, was parallel to the front of the observatory, that is, at right angles to the line running from the camera to the point, *O*, instead of to the center of the picture, that is, the point half-way between *H* and *R*. As the latter position is the usual one for a plate, and was therefore most probably the actual one in this instance, the picture plane made an angle of about 8 degrees with the front of the observatory. Hence, all lines parallel to *H R* were shortened very nearly in the ratio of the cosine of 8 degrees, that is, about one per cent, a quantity too small to affect the results.

AN ELECTRICAL AERIAL FERRY.

BY FRANK C. PERKINS.

The aerial ferry at Duluth, the first structure of its kind in this country, has been completed and is now in operation.

The suspended ferry car has a normal speed of about four miles per hour, but the electrical motors and driving equipment are capable of propelling the car at twice that speed should it become desirable, and the passage of the canal can be made by the suspended ferry car in slightly over one minute.

There are two electric motors, each of 50-horse-power capacity, located under the floors of the car. These electric motors operate two drums, each of which is 9 feet in diameter, and on these drums are wound cables 1 inch in diameter, extending to the truss and then over idle wheels 9 feet in diameter through the inside of the lower chords to tower, where they are fastened, and thus produce the motion which causes the car to travel across the canal.

The canal was adopted by the United States government about four years ago, increasing its width from 240 to 300 feet, and constructing permanent piers of crib-work and concrete. Minnesota Point was con-

THE RECENTLY COMPLETED AERIAL FERRY AT DULUTH.

verted into an island by the opening of the canal, and the city accepted the responsibility of providing the inhabitants with adequate communication with the mainland. A rowboat ferry was first maintained, and finally a steam ferry for the transportation of passengers and freight across the canal was substituted.

The imperative necessity of better communication with the Point at a less cost than was being paid for the steam ferry service resulted in the inception of the aerial bridge scheme.

The idea of the aerial bridge over the Duluth ship canal was received with favor by the United States War Department, and a bond issued by the city of Duluth for the amount of $100,000, the estimated cost of the structure, was sanctioned by the State legislature, and approved by the citizens, and a general specification and contract was prepared and let for the erection of the bridge about four years ago.

A most ingenious arrangement of the track has been provided to carry the car and hangers. It is inclosed on three sides within the box section of the lower chord, and therefore there is no danger in the winter of its becoming coated with sleet or snow. Within the chords there are four rails, two in each, with thirty-two wheels arranged in pairs rolling on the rails and carrying the truck, eight pairs of wheels being employed on each lower chord. The friction of all the working machinery is reduced to a minimum, as the bearings of these wheels as well as those of the drums and idlers are of the roller type. It is stated that the cost of operation of this electrically-operated aerial ferry bridge will not exceed $7,500 per annum, including the interest on the bonds, which will result in a saving of one-third the cost of the steam ferryboat service previously mentioned.

The four principal piers nearest the canal rest on grillage, which is secured on the tops of pilings, driven 35 feet below the level of the lake, while in the foundations of the bridge there are 730 tons of concrete in the eight piers which extend below the water level of Lake Superior. The towers are held in position by twenty-four anchor bolts, each of which measures 2 inches in diameter, and fastened by large washers to the bottom of the pier. There is a clear height above the ordinary stage of Lake Superior of 135 feet, the height of the bridge being fixed by the Lake Carriers' Association to permit the passage of the highest masts. The total height of the highest part of bridge above the water is 186 feet, and the depth of the truss at the center is 51 feet, while the width center to center of the trusses is 34 feet, the clear span being 393.75 feet.

It is stated that the car will carry a loaded double-truck street car, 350 passengers, and two loaded wagons with teams, which is equivalent to about 63 tons, with perfect safety. The car platform measures 50 feet long and 34 feet wide, and contains two inclosed cabins finely finished, 30 feet long and 7 feet wide, in addition to the space for two wagons and a street car. The bottom of the car is elevated above the United States government piers a height of 6 feet, and it rests entirely overland when at rest at either end of the bridge, so that there is no obstruction or menace in any way to navigation. In the construction of this bridge 1,400,000 pounds of steel were required. Before the last 45-foot piece of steel was to be placed in position, it was found that the opening was 3 inches too narrow. The workmen stood guard with tape lines at a height of 135 feet, while both halves of this massive structure were tilted back to enlarge the opening.

Opening of Lewis and Clark Centennial Exposition.

The Lewis and Clark Centennial Exposition was telegraphically opened by the President of the United States. There were present representatives of the State of Oregon, House of Representatives and Senate, the army and navy, and various Western States.

The prelude to the actual opening ceremonies consisted of a military parade, a pageant of federal and State troops, led by Vice-President Fairbanks, the Congressional party, visiting governors, and other dignitaries and the exposition officials.

Portland is rather hurrying her celebration. Lewis and Clark did not come out upon the Pacific coast until November 7, 1806, so that the fair is opened more than a year ahead of time. The Lewis and Clark expedition was the necessary sequel and corollary of the Louisiana Purchase. That purchase carried the western boundary of the United States to the summit, the watershed, of the Rocky Mountain range.

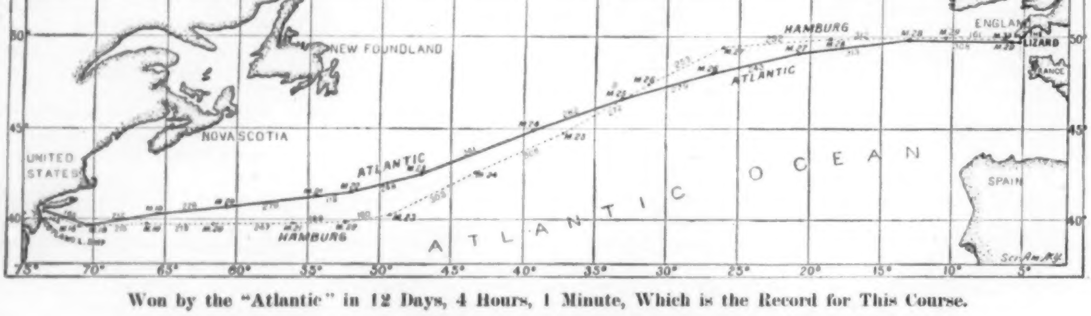
THE FINISH OF THE OCEAN YACHT RACE.

From whatever point of view we look at it, the ocean yacht race for the cup presented by the German Emperor must be regarded as a brilliant success. Not only was the record for the eastern passage broken, but the winning yacht also broke the record for the longest day's run. The "Atlantic" won the Emperor's cup in brilliant fashion, crossing the ocean in 12 days, 4 hours, 1 min. in spite of the fact that she was subjected to an exasperating delay by running into what was almost a flat calm near the finish, in which she took eleven hours and forty-one minutes to sail forty five miles. Had the wind held true, so that this last stretch could have been sailed at her average speed of 10.5 knots per hour, she would have made the run in 11 days and 21 hours. As it was, the performance is an extremely brilliant one and reflects the greatest credit on her talented designer, Mr. William Gardner, of this city, and upon Capt. Barr, of "America" cup fame, who was engaged specially for the race. The single day's run of the "Atlantic" of 341 miles made on May 24 is, indeed, a most extraordinary performance, for she thereby surpasses the previous record of the schooner "Dauntless," made in 1887, by thirteen hours. As the yacht was sailing against the sun, the time from noon to noon was, of course, less than twenty-four hours, and her average speed works out at over 14½ knots an hour. The best previous record over the course sailed by the "Atlantic" was that of the "Endymion," which in favorable winds sailed from Sandy Hook lightship to the Needles in 13 days, 20 hours, and 36 minutes. The "Atlantic," after passing the stake-boat at the Lizard, sailed on to Southampton, which she reached on the afternoon of May 31, well within the "Endymion's" figures.

We stated in our description of the start of the race that the positions of the yachts a few hours after the gun were probably prophetic of their positions at the finish, and with the exception of the "Ailsa" and "Valhalla," which have changed places, this proved to be true. The "Ailsa," which was first over the line, seemed, after a couple of hours sailing, to hold the third position with ease. But she evidently could not compete with the more sturdy cruisers under their own conditions, and fell to the rear, while the "Valhalla," which started something like an hour behind her competitors, surprised the yachting world by working her way through the fleet and finishing in third place.

The performance of the single German entry, the schooner "Hamburg," was exceedingly meritorious, as will be seen by a comparison of her log with that of the "Atlantic." Although the full log, giving the weather encountered by the two yachts, is not yet available, a dispatch sent by one of the guests on the "Atlantic" shows what splendid work the "Hamburg" was doing during the first day of the race. It seems that about half-past five o'clock on the evening of the 17th, and in a freshening wind and roughening sea, the "Hamburg" was about a third of a mile astern of the "Atlantic" and "holding on like a bulldog." By six o'clock she had gained until she was just abeam, and had weathered the port side of the American yacht. "Every stitch of canvas was set that could be spread and sheets trimmed flat. The water was boiling in our lee scuppers," says the same authority, "and the crew in oilskins and sou'westers were lying close up to the weather rail. We felt then that it was nip-and-tuck." At nine o'clock the "Hamburg" was a third of a mile to windward and a little ahead, from which it is evident that to windward, in a roughish sea, the Watson schooner proved rather more than a match for the "Atlantic." As soon, however, as the wind drew around to north and west, and sheets were started, the greater length and large sail spread of the American boat began to tell, and as the logs of the two vessels show, the "Atlantic" drew steadily away from her German rival and made steady gains to the end of the course. The first day out the "Hamburg" ran 142 miles, the "Atlantic" 166 miles. The second day the "Hamburg's" run was 216 knots, that of the "Atlantic" 212 knots. With the exception of the 22d, on which the "Atlantic" encountered light airs and a period of calm, making only 112 knots, her day's runs were all between two and three hundred knots; and on three days she made respectively 308, 313, and 341 knots, this last being the world's record. The "Hamburg" also on three days exceeded 300 knots, making 303, 306, and, on the 29th, 312 knots in the twenty-four hours. The "Hamburg" sailed the longer course, and this is due to the fact that while the "Atlantic" followed approximately a great circle starting from latitude 42 north, the "Hamburg" held a more southerly course, probably to avoid the ice, being in longitude 50 about 120 miles to the south of the course sailed by the "Atlantic," then crossing that vessel's course, until in longitude 26 she was about 80 miles to the north of it.

Although for the greater part of the race the yachts had a fair wind and were sailing with started sheets, they seemed to have experienced every variety of weather from a calm to a full gale. On the "Atlantic" on the day when the great run of 341 miles was made, reefs had to be tied down, as the wind steadily increased to a gale, and on the following day oil bags had to be put over the bow to keep the seas from breaking aboard. The ship made excellent weather, although the foam was knee-deep at the wheel. On May 26 a whole gale was blowing; two steersmen had to be lashed to the wheel to keep them from being washed away and three oil bags were carried over the starboard side. The "Atlantic" finished at 9.16 P. M. on May 29, the "Hamburg" at 7.22 P. M. on May 30, and at eight minutes past eight on the following night, May 31, the full-rigged ship "Valhalla" passed the finish line. Her time for the whole voyage was 14 days, 2 hours and 53 minutes. She was followed an hour and a half later by the schooner "Endymion," whose time was 14 days, 4 hours and 19 minutes. Close at her heels came the "Hildegarde," 14 days, 4 hours, and 53 minutes; then the "Sunbeam," 14 days, 6 hours, 25 minutes, and the "Fleur-de-Lys," 14 days, 9 hours and 33 minutes. The yawl "Ailsa" finished on the morning of June 1, at 4.25 A. M., and she was followed by the three-masted auxiliary schooner Utowana at 5.06 A. M. The "Thistle" crossed the line at 12.44 P. M. on the same day. The last to finish was the big bark "Apache," which evidently did not meet with winds strong enough to suit her very moderate rig.



Won by the "Atlantic" in 12 Days, 4 Hours, 1 Minute, Which is the Record for This Course.

COURSE SAILED BY THE "ATLANTIC" AND "HAMBURG" IN THE OCEAN CUP RACE.

A new variety of sweet potato having great economic value has been acclimated in the experimental gardens of Bordeaux. It is a native of Dahomey and very prolific. The leaves of the plant can be used as a substitute for spinach, and the tubers, containing a higher percentage of sugar than beets, are fine flavored and make exceptionally good food for live stock. At present the authorities have only a limited quantity of tubers, and as these are to be used wholly for reproduction it will not be possible to obtain samples for American experimenters until next year. A few hundred "sprouts" have been distributed among French agriculturists. A box containing ten of these "sprouts" has been placed at the disposition of the American consul, as the representative of the Smithsonian Institution, but as the young growths are extremely fragile and very susceptible to changes of temperature it is feared they may not survive transit to the United States, however well they may be packed.—Albion W. Tourgée, Consul, Bordeaux, France.

A New Tool Steel.

A new tool steel has been placed on the market by a firm of Sheffield makers. Among its advantages it is stated that for hardening the steel only requires to be heated to a bright red, and allowed to cool in the air, when it is ready for use. It can be reannealed, according to the makers, simply by heating the tool to a cherry red, allowing this to become a dark red, and then plunging into water. It then becomes quite soft. In a test with twist drills, this steel drilled 49 holes in steel of 0.49 per cent carbon, each 1.53 inches diameter and 1⅞ inches deep, at an average speed of 25 seconds each, and after the test was still in good condition.

Erratum.

Through an error the article published in the Scientific American for May 27 on "Placing of Printed Matter on Finished Lantern Slides" was credited to Mr. J. A. Honeking. The author of the article is Mr. J. A. Stoneking.

THE BATTLE OF THE SEA OF JAPAN.

RUSSIAN SHIPS SUNK AND CAPTURED AT THE BATTLE OF THE SEA OF JAPAN.

* Vessels Lost.

Name.	Class.	Displacement, Tons.	Speed, Knots.	Armament.	Crew.
Kniaz Suvaroff	Battleship	13,566	18.0	Four 12-in., twelve 6-in., four torpedo tubes	750
Imperator Alexander III	Battleship	13,566	18.0	Four 12-inch, twelve 6- inch, four torpedo tubes	750
Borodino	Battleship	13,566	18.0	Four 12-inch, twelve 6-inch, four torpedo tubes	751
Osliabia	Battleship	12,674	18.3	Four 10-inch, eleven 6-inch, six torpedo tubes	732
Sissoi Veliky	Battleship	9,000	16.0	Four 12-inch, six 6-inch, six torpedo tubes	580
Navarin	Battleship	10,000	16.0	Four 12-inch, eight 6-inch, six torpedo tubes	620
Admiral Nakhimoff	Armored cruiser	8,524	18.5	Eight 8-inch, ten 6-inch, four torpedo tubes	567
Dmitri Donskoi	Armored cruiser	5,880	15.2	Six 6-inch, ten 4.7-inch, four torpedo tubes	510
Vladimir Monomakh	Armored cruiser	6,000	15.3	Five 8-inch, twelve 6-inch, two torpedo tubes	550
Admiral Oushakoff	Coast defense ship	4,648	16.0	Four 9-inch, four 6-inch, four torpedo tubes	318
Izumrud	Protected cruiser	3,206	22.0	Six 4.7-inch, five torpedo tubes	340
Svietlana	Protected cruiser	3,900	20.2	Six 5.9-inch (Canet), four torpedo tubes	380
	Destroyers, six.				
	One repair ship.				
Vessels Captured.					
Orel	Battleship	13,516	18.0	Four 12-in., twelve 6-in., four torpedo tubes (submerged)	740
Imperator Nikolai I	Battleship	9,672	14.8	Two 12-inch, four 9-inch, eight 6-in., six torpedo tubes	604
Gen. Ad. Apraxine	Coast defense ship	4,126	15.0	Three 10-inch, four 6-inch, four torpedo tubes	318
Admiral Seniavin	Coast defense ship	4,792	16.0	Four 9-inch, four 6-inch, four torpedo tubes	318
Biedovy	Destroyer	350	22.0	Torpedoes and quick-firers	110

* The cruisers Jemtchug, Oleg and Aurora escaped to Manila.

The battle of the Sea of Japan is destined to go down into naval history as one of the most momentous sea fights that has ever determined the destinies of nations. It was a three days' struggle, that commenced on the afternoon of May 27, continued through the night to the following Sunday morning; was waged in its various phases throughout that day and night, and was only concluded on the following morning by the capture or sinking or flight of the last of the great Baltic fleet. Of this formidable fleet but one vessel of any size or importance, the "Almaz," a fast, 3,000-ton cruiser of the "Novik" type, is known definitely to have escaped to the home port of Vladivostock. It was a fair "stand-up" fight between two antagonists, who had been preparing for each other in the expectation of just such a meeting as this for many long months preceding. On paper, at least, they were fairly equal in strength—that is, if the comparison be made on the basis of displacement, number of ships engaged, total weight of armor, and total weight of broadside fire delivered. But on this basis only can it be said that there was any equality. For while the Japanese fleet was homogeneous, and embodied in its make-up, in their proper relative proportion as to numbers, all the component elements of battleships, armored cruisers, protected cruisers, scouts, destroyers, and torpedo boats, that should go to form the composition of a modern fleet, the Russian fleet consisted of a heterogeneous collection (if we except their four splendid battleships of the "Borodino" class) of vessels of widely different type, age, and speed—a fatal defect, that undoubtedly had much to do with the awful disaster that overtook it. It is quite a question whether Rojestvensky would not have made a better fight with his five modern 18-knot battleships, had he not been encumbered with the three low-speed coast-defense ships of the "Admiral Apraxine" type, and the three obsolete armored cruisers "Nakhimoff," "Donskoi," and "Monomakh." Had it not been for the presence of this "old timber," with its small coal supply and limited radius, Rojestvensky would doubtless have passed into the Pacific, south of Japan, and attempted to gain Vladivostock by way of the Pacific Ocean. The coast defense vessels and older cruisers, however, could not carry sufficient coal for so long a trip, and it was out of the question for him to encumber himself, on his final dash, with colliers. Hence, in making the last move of this forlorn hope, there was nothing for him to do but dispatch his transports and colliers to the Chinese coast, and steam north in the attempt to force the passage of the Korean Straits.

And just here let us pay a fitting word of tribute to the part played by the two admirals in the months leading up to the final tragedy of this naval war. In our admiration of Togo, we are in danger of forgetting the unparalleled feat performed by Rojestvensky in bringing a fleet of half a hundred vessels intact through a voyage equal to nearly three-quarters the circumference of the globe, and being able to confront the victorious Japanese, flushed with recent victories, with a battle array which seemed approximately equal to their own. The continuous mental strain and the ever-present apprehensions of that extraordinary voyage can only be fully appreciated by the brother officers of Rojestvensky throughout the world. For, it must be remembered, there were three separate fleets sailing over three different routes that had to be gathered at certain rendezvous; that they were dependent for their mobility upon hundreds of transports and colliers, all of which were liable to capture by the enemy; and that from the time of setting out from the Baltic until the enemy was sighted on that fatal Saturday afternoon, Rojestvensky and his officers did not know but that at any moment the enemy might be encountered in force, or a death-dealing torpedo flotilla might launch its fatal strokes in a night attack. Moreover, it was known from the very start that there was no friendly port in which harborage might be sought for refitting or repair; that the only port of refuge was a single harbor in the far North, barring the path to which lay a victorious and confident enemy that had never known defeat. Too much praise cannot be given to Rojestvensky for his successful navigation from the Baltic to the Sea of Japan, and for the bold attack that he launched at the Japanese fleet on ground that had been carefully chosen by themselves. Of his tactics in the actual engagement it is too early to speak. We shall have to await the coming of fuller details, before it can be determined whether, having no alternative but to force the passage of the straits, the disposition and tactics of the Russian admiral were commendable or not. Once in the fight, however, Rojestvensky fought with all the heroic tenacity of his race. His flagship was sunk beneath his feet, and he was finally captured on the destroyer to which he had been transferred in a sorely wounded condition.

Of Admiral Togo it must be admitted that the self-restraint with which he awaited the coming of the Russians after they had been sighted in the Malacca Straits is fully as admirable as the terrific but well-controlled fury with which he attacked them in his own chosen place. It is one of the marvels of the Japanese race that they combine such wide extremes of character. Fierce as a tiger in attack, they can be as patient in waiting the critical hour to strike. There were the strongest motives to induce Admiral Togo to go to the southward, meet the Russians in their scattered condition, and defeat them in detail. Not only the amateur strategist, but pretty nearly every naval expert who has spoken his mind, here and in Europe, predicted a battle in the Malacca Straits or the Chinese Sea, and the gradual decimation of the Baltic fleet as it struggled northward toward Vladivostock. Why, it was asked, do not the Japanese send their swift cruisers to intercept the colliers, upon which Rojestvensky depends so absolutely for the mobility of his ships? Why does not Togo attack the first division of the fleet, before it is strengthened by the re-enforcement of Nebogatoff and his squadron of ironclads and armored cruisers? Why does he not place his torpedo flotillas in some sheltering bay or inlet, and make a dash upon the fleet as it passes in the night?

The answer to these questions was made many months ago, when one of the officials in Tokio—we forget his name—on being asked if he thought the Baltic fleet would come out, significantly remarked, "We sincerely hope it will." In the light of subsequent events, it can scarcely be doubted that immediately upon the fall of Port Arthur and destruction of the first eastern squadron, Togo and his officers were anxious that Russia would dispatch to the Far East every vessel that she could possibly get in commission; for there can be little doubt, judging from their evidently pre-concerted plan of enticing the Russian fleet into the Sea of Japan, that they were perfectly satisfied that every ship that left the Baltic would be a ship lost to the Russian imperial navy. That they were right was proved with a completeness that must have astonished even the Japanese themselves. For out of that awful tragedy in the Sea of Japan there escaped to Vladivostock a solitary cruiser and one or two torpedo boats, to tell of the final obliteration not merely of the Russian fleet, but of the Russian navy itself—for outside of a few modern battleships locked up by treaty in the Black Sea, Russia's modern navy does not exist. Except for a few obsolete cruisers and battleships in the Baltic, and two or three battered cruisers at Vladivostock, Russia is to-day literally without a navy that she can use on the high seas.

The more complete story of the battle of the Sea of Japan must be reserved for a later day. From what has come to hand we know that Togo had taken station at the harbor of Masampho on the coast of Korea. His fleet consisted of four first-class battleships, one coast-defense vessel, eight armored cruisers, eleven protected cruisers, and four scout cruisers of between two and three thousand tons displacement. Of destroyers he had from twenty to twenty-five, and double that number of torpedo boats. Add to these possibly half a dozen submarines and twenty to thirty auxiliaries, and we have the total of the Japanese fleet. Against this Rojestvensky was advancing with eight battleships, of which five were modern, three coast-defense ships, three armored cruisers, and six protected cruisers. He probably had about a dozen torpedo-boat destroyers, two hospital ships, a repair ship, and a tank vessel. The Russian fleet was sighted at six o'clock on the morning of the 27th of May between Goto and Quelpart Islands, entering the Korean Straits, in double column, the battleships forming the starboard column, and the coast defenders, armored cruisers, and protected cruisers the port column. On the Japanese scouts getting in touch with the Russians, Admiral Togo was informed, by wireless telegraphy, of their approach, and the Japanese fleet moved eastward across the northerly end of Tsu Island, and turned south so as to bar the narrow strait between Tsu Island and the Japanese coast. Rojestvensky entered the eastern channel, and steamed steadily ahead in the direction of the approaching Japanese fleet. Admiral Togo turned, and placing his fleet parallel with the Russians and apparently to the westward of them, repeated his usual tactics of a long-range running fight. His position gave him the great advantage that being to the westward of the Russians, the latter were at the enormous disadvantage of having the sun directly in their eyes. The effect of the Japanese fire was soon apparent and Rojestvensky's flagship, "Kniaz Suvaroff," settled by the head and finally sank. The Japanese appear to have gradually enveloped the Russians, and when they had shaken their *morale* and thrown their line into disorder, they drew in to closer range and began to wreck the ships piecemeal with an accurate and fearfully effective gunfire. The "Borodino" had her forward turret wrecked, her ammunition hoists shot away, 400 of her crew disabled, and finally, after being repeatedly hulled, was sunk by a torpedo. The "Alexander III.," "Osliabia" and "Navarin" shared her fate. Then night came down on the tragedy, and under its pall the torpedo divisions dashed in upon the huddled and disorganized Russians.

Meanwhile the contending fleets were moving to the northward, and at dawn the battle seems to have resolved itself into a veritable *melée*. Admiral Rojestvensky, who had been taken off the sinking "Suvaroff" by a torpedo boat, was overhauled and captured by one of the Japanese destroyers. Admiral Nebogatoff, with his coast defenders and the battleships "Orel" and "Nikolai I.," managed to get as far north as the Liancourt Rocks, where, after the loss of the coast defender "Oushakoff," he surrendered with the "Nikolai I.," the battleship "Orel," and the coast defenders "Seniavin" and "Apraxine." By this time all of the battleships had been sunk or captured, and later the cruisers "Svietlana" and "Dmitri Donskoi" were sunk. All through the night of Sunday and well on into the opening day of the week the pursuit of the remnant of the flying squadron was continued, until Admiral Togo was ultimately able to announce to the Mikado that the great Baltic fleet was literally annihilated. The loss includes six battleships, three armored cruisers, one coast-defense vessel, two protected cruisers, six destroyers, and two special-service ships, including the invaluable repair ship "Kamschatka." The captures include the battleships "Nikolai I." and "Orel," two coast-defense vessels, and one destroyer, while there escaped the "Almaz," which arrived at Vladivostock, and the "Izumrud," which was run upon the rocks and destroyed by her commander. "Jemtchug," "Oleg," "Aurora" are at Manila. A converted cruiser and mine-laying ship seemed to have arrived at Wusung, China. The loss of life has been appalling, and is estimated at about 7,000 men, and some 4,000 have been captured, including Admirals Rojestvensky and Nebogatoff. The casualties to the Japanese fleet were astonishingly small. None of the battleships or cruisers appears to have been seriously hurt, and the losses are confined to three torpedo-boat destroyers and some 550 killed and wounded.

As the immediate result of the victory, the Japanese government has announced that the high seas are cleared of the enemy, and that Japanese shipping is now free to come and go as it pleases. The threatened interruption of communications with Manchuria is removed; men and supplies may be poured into Manchuria with greater freedom than ever, and the whole Japanese fleet is now available for the blockade of Vladivostock and its reduction in co-operation with the Japanese land forces.

A cubic foot of earth weighs about five and a half times as much as a cubic foot of water. A cubic mile of earth then weighs 25,649,300,000 tons. The volume of the earth is 259,880,000,000 cubic miles. The weight of the world without its atmosphere is 6,666,250,000,000,000,000,000 tons. If we add to this the weight of the atmosphere given above we get a grand total—6,666,255,819,600,000,000,000 tons. No wonder, says the American Machinist, Atlas became round-shouldered.

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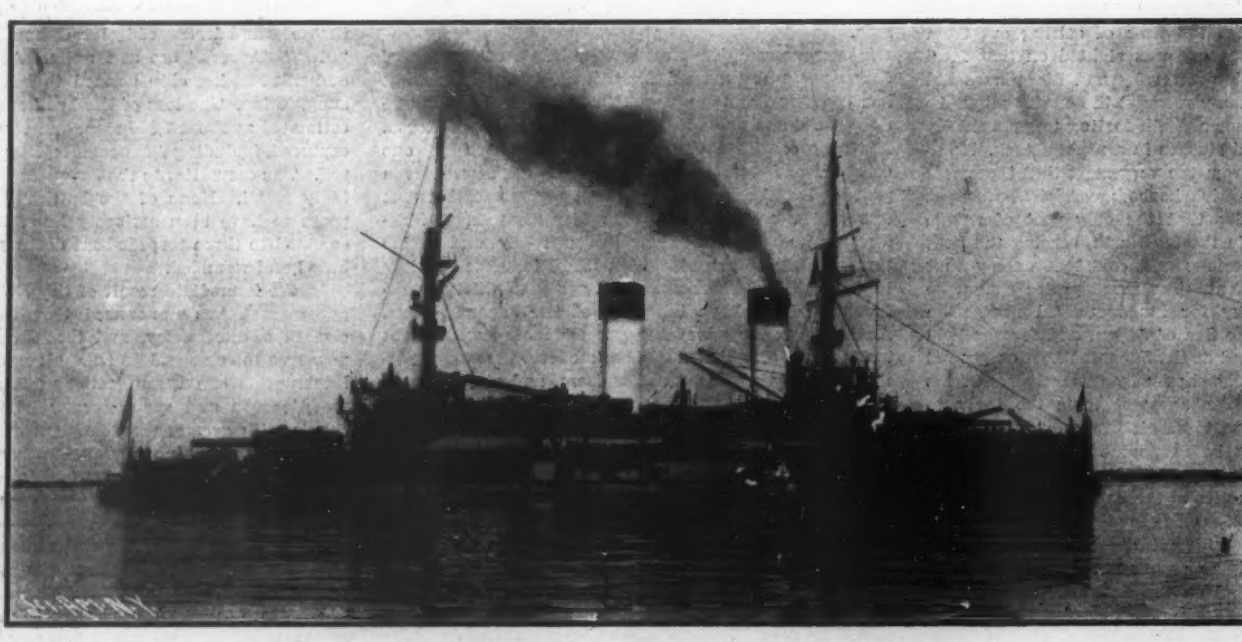
ADMIRAL TOGO'S FAMOUS FLAGSHIP "MIKASA" IN ACTION.

From This Flagship Admiral Togo Directed and Won the Great Battle of the Sea of Japan.



The "Borodino," One of the Four Finest Battleships of the Baltic Fleet, Fought a Terrific Battle, Until She Succumbed to Gunfire and the Torpedo, and Went Down with Colors Flying.

ADMIRAL ROJESTVENSKY'S FLAGSHIP "BORODINO."

ADMIRAL TOGO AND HIS FLAGSHIP.

To speak of Admiral Togo is to think of his flagship the "Mikasa," and wherever in the stirring events of the war the "Mikasa" has been mentioned, there we know the gallant little admiral has been present, holding in his hands the naval destinies of his country and the fate of the Russian fleets. As Nelson and the "Victory" are the most famous names in the annals of naval warfare in the nineteenth century, so Togo and the "Mikasa" stand out in the opening years of the twentieth century and bid fair, indeed, to become the most notable historic figures when the naval history of the century shall come to be written.

In the presence of such a sweeping victory as that achieved over the Baltic fleet in the Straits of Korea, it is easy to fall into exaggerated expression and give to this Japanese admiral credit even greater than his due; on the other hand, the critic who seeks a questionable distinction by invariably running counter to popular approval will tell us that the Japanese success is due more to Russian imbecility than to their own skill and courage. Yet we can hardly conceive anything more ungenerous than to seek to depreciate the superb achievements of the Japanese fleet in this, the crowning hour of their triumph. Togo must be judged by the facts as we see them to-day, and baldly stated they are as follows: With a fleet which was so small and so youthful among the great fleets of the world that it was not even reckoned as of the first class, Admiral Togo did not hesitate to match himself against the third greatest naval power in existence, a power which in numbers and weight of ships, extent of resources, and ability to stand a long-drawn-out war, was fully three times as great as his own; that at the very outset he dashed in and crippled a powerful and selected fleet of the enemy while it was sheltered behind the guns of a first-class modern fortress; that throughout the inclement weather of a stormy and tempestuous winter he blockaded the enemy within the shelter of that fortress, repeatedly driving him to take refuge under its guns, and finally smashing his fleet in a fiercely contested battle upon the high seas; that after practically wiping out the first Pacific fleet, he retired for two or three months' rest and refitting, and then threw himself across the path of an even larger, and in some respects more modern fleet dispatched for his undoing from the home ports, and literally swept it from the high seas; and finally, that after literally annihilating the third greatest naval power in the world, the forces with which he has accomplished this stupendous task are practically, thanks to captures from the enemy, and fresh constructions carried on in the home dockyards during the war, as strong as they were sixteen months ago, when the war began.

Admiral Togo comes of a race of sailors and sea fighters. He was born in 1857 at the time of Japan's awakening, and therefore, being but 48 years of age, he is in the prime of life. He saw the beginnings of the new Japanese navy and he was one of the first Japanese youths to be sent abroad to study, spend-

ing three years in the famous British naval college at Greenwich. On returning to Japan he was enrolled in the Japanese navy as an ensign, and on the opening of the war with China in 1894 he had risen to the command of the then crack cruiser "Naniwa," of 3,650 tons. It is a curious fact that in that war, as in this, he struck the first serious blow, for the "Naniwa" on coming up with a Chinese transport, the "Kowshing," of which he had been sent in search, ordered her to heave to, and on her refusing promptly sent her to the bottom.

After Leaving the Cooler, the Milk Runs into a Large Tank, from Which It is Drawn into the Bottles.

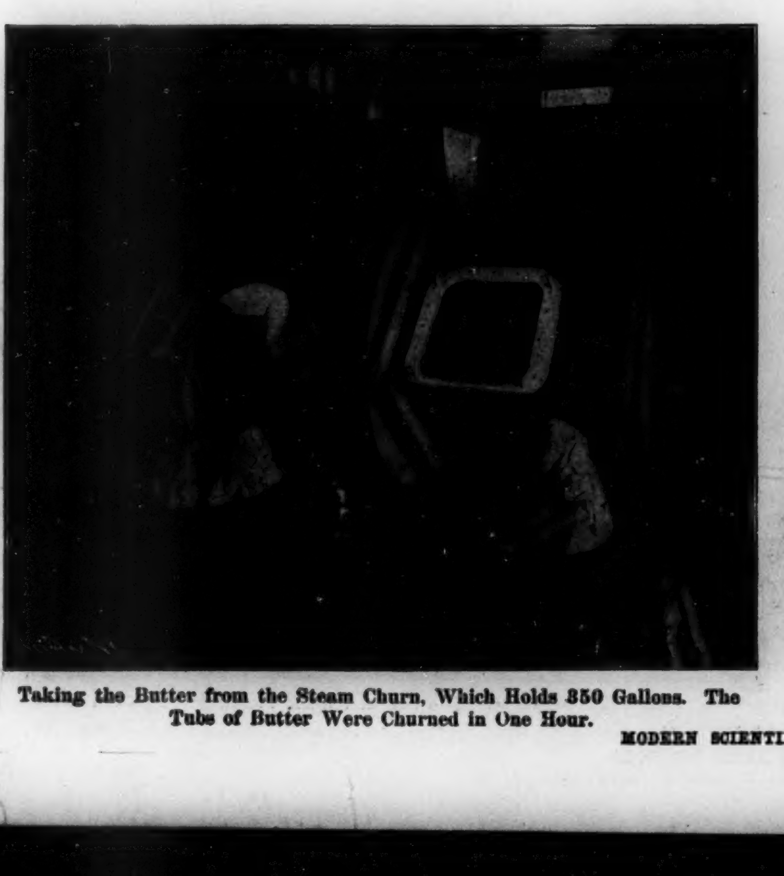
For his distinguished services in the Chinese war, 1894-5, he was given two Japanese orders and a pension. He was appointed a member of the board of admirals in 1895. For his service in Formosa he received further rewards, and he was appointed vice-admiral in June, 1898, with the commission of commander-in-chief of Sasebo naval station. In 1900 he was appointed commander-in-chief of the standing squadron, and during the diplomatic controversy at the close of 1903 that led up to the present war he was appointed commander-in-chief of the first fleet. The naval *attaché* of the Japanese legation, Washington, states that Admiral Togo has well earned his sobriquet of "the silent man." Before the war, among the Japanese naval officers, he was held in the very highest repute as a strategist and fighter, and his conduct of the war, and the fact that after destroying one of the greatest of naval powers he should have in hand a fleet practically as powerful as that with which the war opened, proclaims Admiral Togo as one of the very greatest admirals of this or any other age. What he has done has not only never been equaled, but has never been approached.

The first-class battleship "Mikasa," Togo's flagship throughout the war, is probably better known than any other ship that has figured in the present conflict. Built by Vickers, Sons & Maxim at Barrow, she was at the time of her launch in 1900 the largest battleship afloat, and at the opening of the war she was the largest battleship in commission in any navy. With a length over all of 436 feet, beam of 76 feet, and a draft of 27¼ feet, she displaces 15,200 tons. She is a thoroughly up-to-date vessel, and includes the accepted ideas as to speed, armor, and armament of naval designers. The only points on which ships of later design surpass her are those which are due to the lessons that have been taught by the war in which the "Mikasa" has figured so largely; namely, the substitution of large guns of from 9 to 10-inch caliber, emplaced in turrets, for the more numerous battery of 6-inch guns mounted behind side armor which constitutes the secondary armament of the "Mikasa" and her type of battleship. She is driven by twin triple-expansion engines, for which steam is supplied by a battery of twenty-five Belleville water-tube boilers. As in the other battleships of the Japanese navy the main battery consists of four 12-inch wire-wound guns of high velocity; the secondary battery is made up of fourteen 6-inch guns. For protection the vessel carries a 9-inch belt of Krupp steel and a wall of side armor 6 inches in thickness extending amidships from the main belt to the main deck. The very striking picture of the "Mikasa" which we herewith reproduce represents her leading the Japanese fleet into an engagement. She is stripped of her boats, rails, stanchions, and everything that might interfere with gun fire or, by intercepting the enemy's shells, burst them and be knocked into flying splinters that would endanger the crew. The "Mikasa" has been present and taken a prominent part in all the battleship engagements of the war. She has been subject to attack by the guns of the enemy's fleet, by the coast defense guns of Port Arthur's fortifications, and by the deadly mine and torpedo. Yet to-day, as far as we can learn, she is in first-class fighting condition.

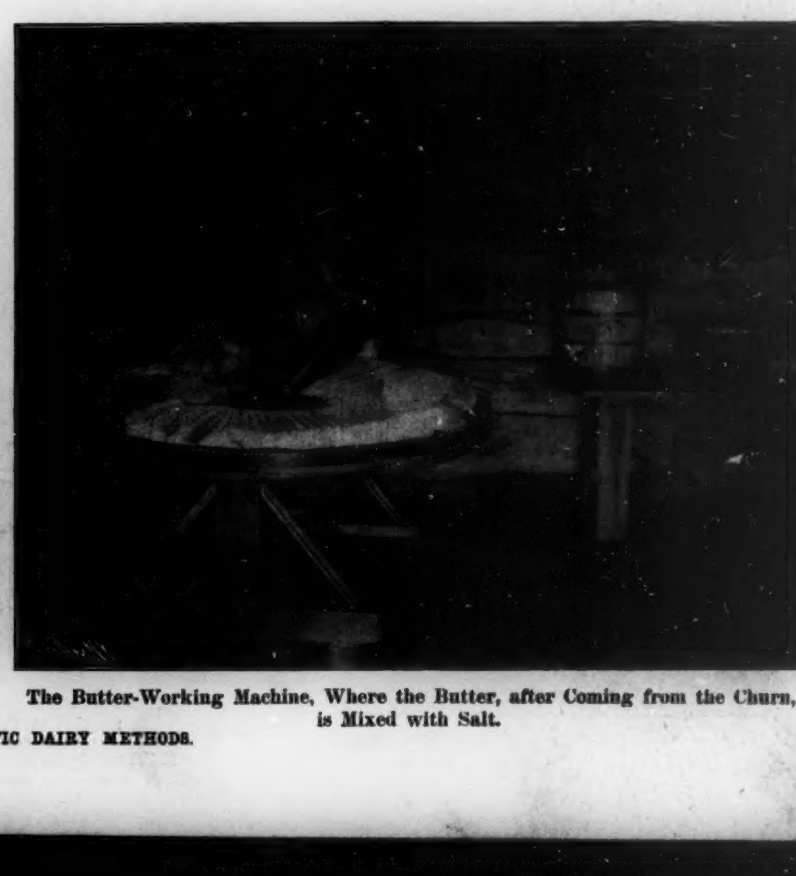
MODERN SCIENTIFIC DAIRY METHODS.

New York city drinks two million quarts of milk every day. Could this milk be delivered to the consumer within an hour or so from the time it is milked, there would be little danger of its spreading disease, provided it came from healthy cows and was handled with due precautions. But, unfortunately, our transportation systems have not been so highly developed as to permit of such rapid delivery. The supply is brought in from distant farms in New Jersey, Connecticut, central New York State, and Vermont. Even if fairly clean when shipped, which is not often the case, the long journey permits the growth of millions of bacteria, so that by the time it passes through the distributing station, and is finally delivered to the consumer, the milk may be teeming with all kinds of germs. Of course, most of these germs are harmless. Nevertheless, milk affords an excellent breeding ground for all bacteria, and should any disease germs gain access to it, they would in a few hours multiply to an astonishing number. The milk of a healthy cow contains, at the outset, only very few bacteria per cubic centimeter; but by the time it arrives in this city it seldom contains less than four hundred thousand bacteria, with the exception of certified milk, and often as many as six or seven million bacteria per cubic centimeter. A cubic centimeter, by the way, is equivalent to less than one-third of a teaspoonful. After this many hours may elapse before the milk is delivered, and then it may be exposed to all the filth and disease of a tenement for hours, ere it is finally fed to some sickly infant. Small wonder that the death rate in the tenement district is so high.

In Germany and France, the law requires much greater care to be exercised in the handling of milk, and all milk that is brought into the cities must be pasteurized before delivery. Within the last two or three years, modern dairy machinery has been introduced into this country, and we can now boast of a number of establishments in which the milk is purified both by destroying the bacteria and by filtering out all dirt and foreign substances. Our engravings illustrate the apparatus installed in one of these enterprising dairies. The milk, as it comes from the farms in ten-gallon cans, is poured into a receiving vat, shown at the extreme left in one of the illustrations, and is thence pumped up to an elevated reservoir. From this point it flows by gravity through the filter and pasteurizer. The pump used for elevating the milk is of a new design. Every part that comes in contact with the milk is made of brass, nickel-plated, and the pump is so constructed that it may be readily taken apart and cleaned. The filter comprises three strainers, each covered with a four-inch layer of pure quartz sand, which arrests all foreign substances in the milk. The sand is washed and sterilized every day in a special machine. From the filter the milk passes through the pasteurizer, which is built on what is known as the "regenerative" plan. A better idea of this apparatus may be had from the section view, shown herewith. The pipe leading from the filter opens into the receptacle, *H*, whence the milk flows



Taking the Butter from the Steam Churn, Which Holds 350 Gallons. The Tubs of Butter Were Churned in One Hour.



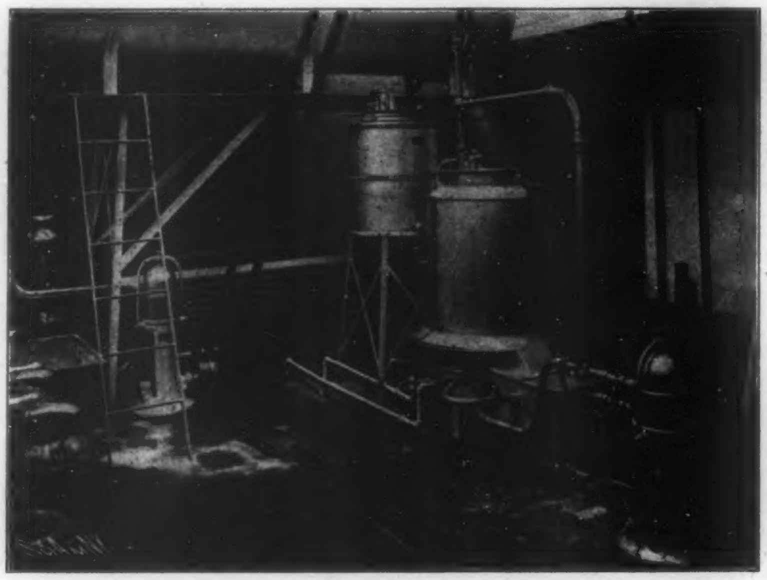
The Butter-Working Machine, Where the Butter, after Coming from the Churn, is Mixed with Salt.

MODERN SCIENTIFIC DAIRY METHODS.

down over the corrugated casing, *A*, to the trough, *B*, and thence into a tank below (shown in the photograph). From the tank it is forced by one of the sanitary pumps above described, through pipe, *C*, to the top of the inner chamber of the pasteurizer, down the annular space between the steam chamber, *D*, and a bell, *E*, and up again between this bell and the outer corrugated casing, as indicated by the arrows. The bell, *E*, is rapidly rotated to prevent the milk from adhering to the heating chamber, and its walls are hollowed and filled with heat-insulating material, to prevent the passage of heat from the inner side of the bell to the outer side. This arrangement is very clever, and results in a great saving of heat. The milk reaches its highest temperature at the point, *I*, where the thermometer, *T*, should register 164 deg. F. From this point an exchange of temperature takes place between the hot milk, rising within the corrugated cylinder, *A*, and the cold milk flowing down its outer surface. The latter which, in receptacle, *H*, registers about 40 deg. F., becomes heated to 120 deg. by the time it reaches the trough, *B*; while the hot milk within is cooled to about 90 deg. by the time it reaches the outlet, *F*. It is estimated that by this construction a saving of 60 to 65 per cent of the steam is effected over the old-style heaters. The requirements in this country are different from those in Europe, where pasteurizing is enforced by law. In Germany the milk is heated to a higher temperature, thoroughly sterilizing it and entirely destroying all bacteria. This, however, results in a chemical combination of the milk and cream which we Americans object to. Our custom requires that the milk should show a "cream line." Under these conditions the highest temperature to which the milk can with safety be raised is 168 deg., and then the heat must be immediately lowered. At this temperature most of the bacteria are destroyed, but about 20,000 per cubic centimeter are left. However, this is as pure as the milk sold as certified milk.

From the pasteurizer, the milk is conducted to the cooler, which is specially designed to provide a large cooling surface and prevent too rapid flow of the milk. It is built up of coils of pipe of triangular cross section with flat faces upward, thus forming stepped or corrugated surfaces, over which the milk flows. Cold water runs through the upper half of the cooler, and a freezing mixture from a refrigerating machine through the lower half. From the cooler the milk passes to a bottle-filling machine, which fills a large number of bottles at a time. The filled bottles are kept in a cold storage room to await shipment to customers. In this room a temperature of 30 deg. is maintained, which prevents breeding of the bacteria. The empty bottles are soaked, washed, and sterilized in the basement of the building, and brought up to the main floor by means of a conveyor, which is interesting from a mechanical point of view. The milk cans, after being emptied in the receiving vat, are washed and sterilized in a special machine before being sent back to the dairy farm.

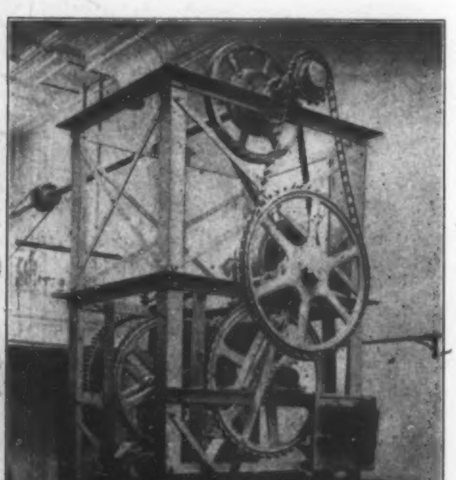
Aside from its direct use for city consumption, milk is employed in large quantities for the manufacture of butter, cheese, casein, etc. In the manufacture of butter, the milk is first heated or pasteurized and then run through a separator at blood temperature, that is, 98 deg. F. This machine whirls the milk around at a rate of 6,000 revolutions per minute, separating it by centrifugal force into cream and skim milk, the latter, due to its greater weight, being thrown to the periphery of the revolving receptacle. The smaller separators run even as high as 11,000 revolutions per minute. De Laval, the well-known Swedish engineer, is one of the men who brought this machine to perfection, and as a matter of fact his steam turbine was developed after experiments with the De Laval separator. The other machines and apparatus we have described are the invention of Mr. Joseph Willman, an enterprising German inventor.



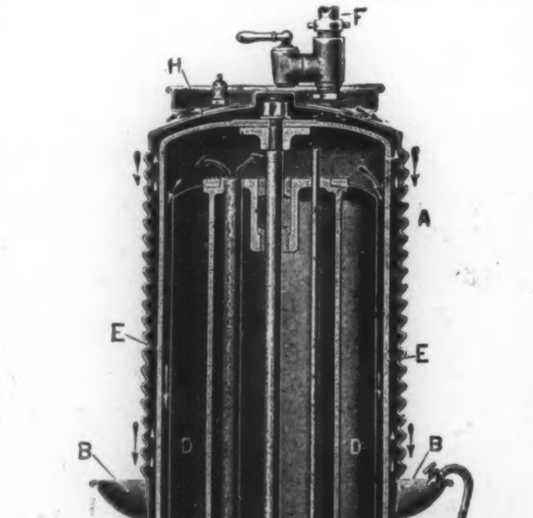
The Strainer and Pasteurizer.

The milk is pumped from vat at extreme left to reservoir above, whence it flows through the filters and over exterior of pasteurizer to the tank shown in foreground, whence it is pumped back through interior of pasteurizer.

After the cream leaves the separator, it is first cooled and then run into a ripening vat, where it is ripened (that is, slightly soured) by means of a special ripener made of skim milk. On the following morning it is drawn off into a churn, where it is churned into butter. To remove the buttermilk, it is brought onto a butter worker and salted with two to three per cent salt. Then it is put in cold storage, and on the next day again worked over to remove the salt water. The skim milk is cooled after coming from the separator and returned to the farmers, who use it for feeding calves, hogs, etc., or else it is treated with acid, tried, and turned into casein. The latest use of casein is for a substitute of celluloid. Skim milk is also reduced to powdered form, and employed in large quantities in the Russian and Japanese armies.

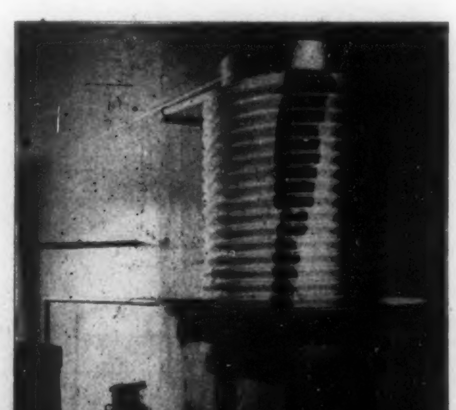


Elevator for Conveying Empty Bottles to and from the Washing Machine in Basement.



Section of the Pasteurizer.

MODERN SCIENTIFIC DAIRY METHODS.



The Cream Cooler, Containing Ice-Cold Brine.

The cream from the separator flows over the corrugated exterior and thence into cans.

Earthquakes.

On this topic Audubon wrote (quoting from a recent number of Science):

"Traveling through the Barrens of Kentucky . . . in the month of November (1812), I was jogging on one afternoon, when I remarked a sudden and strange darkness rising from the western horizon. Accustomed to our heavy storms of thunder and rain, I took no more notice of it, as I thought the speed of my horse might enable me to get under shelter of the roof of an acquaintance, who lived not far distant, before it should come up. I had proceeded about a mile when I heard what I imagined to be the distant rumbling of a violent tornado, on which I spurred my steed, with a wish to gallop as fast as possible to a place of shelter; but it would not do, the animal knew better than I what was forthcoming, and instead of going faster, so nearly stopped that I remarked he placed one foot after another on the ground, with as much precaution as if walking on a smooth sheet of ice. I thought he had suddenly foundered, and, speaking to him, was on the point of dismounting and leading him, when he all of a sudden fell a-groaning piteously, hung his head, spread out his four legs as if to save himself from falling, and stood stock still, continuing to groan. I thought my horse was about to die, and would have sprung from his back had a minute more elapsed, but at that instant all the shrubs and trees began to move from their very roots, the ground rose and fell in successive furrows, like the ruffled waters of a lake, and I became bewildered in my ideas, as I too plainly discovered that all this awful commotion in nature was the result of an earthquake. . . . The fearful convulsion, however, lasted only a few minutes, and the heavens again brightened as quickly as they had become obscured; my horse brought his feet to their natural position, raised his head, and galloped off as if loose and frolicking without a rider. . . . Shock succeeded shock almost every day or night for several weeks, diminishing, however, so gradually as to dwindle away into mere vibrations of the earth. Strange to say, I for one became so accustomed to the feeling as rather to enjoy the fears manifested by others. . . . The earthquake produced more serious consequences in other places."

A reversible petrol engine was described recently in France Automobile. In principle this engine makes use of an extreme retardation of the ignition for slowing up the engine, the exhaust valve being raised at the same time; at the instant of oscillating before stopping the ignition circuit is interrupted, the valve striker falls into a different guiding channel—these channels take the place of the usual cams—and ignition can then take place with the spark moderately advanced in the new direction of rotation.

AN OLD HIGH-SPEED LOCOMOTIVE.

BY HERBERT T. WALKER.

The locomotive engine is now more than one hundred years old, and has attained a degree of perfection that is little short of marvelous, even to those who have given the subject but superficial study. Like other highly developed pieces of mechanism, its various parts and their co-relation and proportions have been slowly evolved by years of intense thought and study on the part of men who, having but few precedents for their guidance, were often confronted by problems which could only be solved by a wearisome process of trial and error, and under adverse conditions unknown to the engineer of to-day.

It is true that the problems of modern locomotive design still demand much study; but in the way of proportions of parts, such rules, as for instance the ratio of grate area to heating surface, the diameter of driving wheels to length of piston stroke, the adhesive weight to tractive effort, and so on, have been, by this time, fairly well established. It is thus comparatively easy for the modern engineer to design a locomotive, since he has all the rules, data, and literature ready to hand, and skilled mechanics with the finest tools waiting to incorporate his ideas; so that the genius of such men as Trevithick, Hackworth, and Stephenson, who not only originated their designs, but often built the engines themselves, becomes at once apparent. In short, the early locomotive engineers were living examples of the aphorism that "failures are the pillars of success."

With these preliminary remarks, and before introducing a peculiar and interesting locomotive to the reader, it is necessary to call attention to the fact that the locomotive engine is an offshoot of the stationary engine, and its early examples (except those of Trevithick) show the influence of the fixed engine developed by James Watt, which accounts for most of the oldest locomotives having upright cylinders, vibrating beams, and low piston speed. Even the rails were laid on stone sleepers, after the manner of stationary engine foundations. When the locomotive had assumed practically the same arrangement of parts and general appearance which it has to-day, the influence of stationary engine practice still clung to it, and one of the principles governing locomotive design was that the piston speed should be kept as nearly as possible to the usual rate of Watt's pumping engines, namely, 220 feet per minute. With this absurdly low rate as a standard, the only way to build a high-speed locomotive was to enlarge the diameter of the driving wheels, and this fallacy led to the production of some engines with wheels of no less than 10 feet diameter (even 15 feet were proposed) which, after a few trials, were soon laid aside and broken up. As the size of driving wheels could not be increased without raising the boiler, the early locomotive men found themselves confronted by another dilemma, namely, the "low-boiler" theory, by which it was held that the boiler of a locomotive should be kept as near to the rails as possible to insure steadiness and safety at high speeds. This, like other imaginary troubles, proved to be the most serious obstacle in the path of true and practical progress, and a book could be written describing the fearful and wonderful designs introduced by men both in and out of the profession to meet a difficulty which had absolutely no foundation in fact.

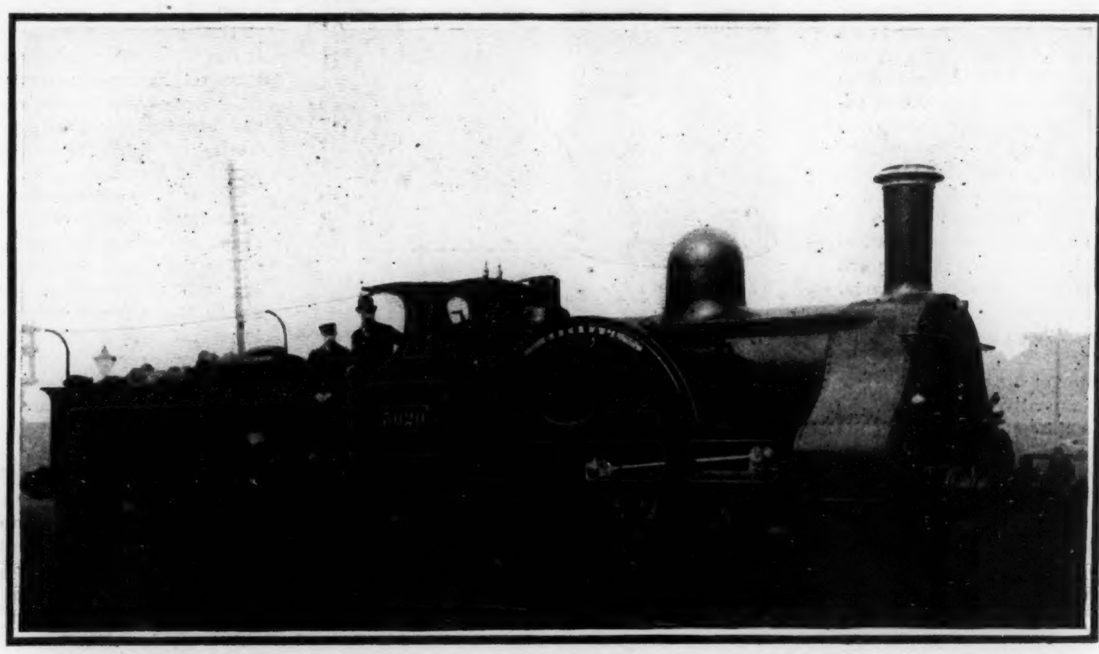


Fig. 2.—Express Engine "Cornwall" as It is Running To-day. Largest Driving Wheels in the World.

One of the most prominent engineers to grapple with the low-boiler problem was Francis Trevithick, a son of the renowned "father of the locomotive." He was chief mechanical superintendent of the northern division of the London and North-Western Railway, England, and in order to compete with the broad-gage Great Western Railway, which had some fast engines with 8-foot driving wheels, he determined to produce a standard-gage engine, which should eclipse all others for size of wheels and speed. He conceived the idea of placing the boiler below the driving axle, and his designs were embodied in the remarkable engine shown in Fig. 1, in which the outline of the boiler is indicated by dotted lines. This locomotive was built at the Crewe Works, England, in November, 1847, and was named "Cornwall," after Trevithick's native county.

The bottom of the boiler at the front end was cut away to make room for the axles of the leading wheels, so that the tubes in the lower rows were shorter than the others. This was not a good design, and its defects were soon made manifest under the severe strains inseparable from high speeds. The axle of the trailing wheels passed through the fire-box by way of a circular water bridge, and upright water tubes connected this bridge with the crown sheet to insure good circulation.

Following are some of the leading dimensions: Cylinders, 17½ inches diameter by 24 inches stroke; diameter of driving wheels, 8 feet 6 inches; weight in working order, 27 long tons. In Sekon's "Evolution of the Steam Locomotive," the heating surface is given as 1,046 square feet. The valve motion was outside the driving wheels, and one eccentric actuated a vibrating arm which worked the feed pump.

A speed of 117 miles an hour has been claimed for this engine when going down the Madeley Bank on a trial trip, but this statement must be accepted with reserve, as the special instruments we now have for ascertaining railway speeds were unknown in those days, and on the occasion in question the timing was probably done with an ordinary stop watch. However this may have been, the engine certainly attained a speed of fully 79 miles an hour when running under favorable circumstances, and this was very good for the year 1847—exceeding, as it did, the highest speeds made by Gooch's best engines on the broad gage.

In the year 1851, the "Cornwall" was shown at the London International Exhibition, which, as is generally known, was the first "World's Fair" ever held. As originally built, the engine had two steam domes, but when placed in the exhibition the domes had apparently been removed and at least one safety-valve column substituted on the fire-box, as shown in Fig. 1, which is a copy of the engraving published in the Exhibition catalogue. A medal was awarded for this engine by the Exhibition judges.

This engine hauled express trains for about nine years, when in November, 1858, it was rebuilt as a six-wheel engine, with a standard boiler above the driving axle. Since then it has been twice overhauled, and fitted with modern improvements. For years it ran the express trains between Manchester and Liverpool, covering the distance in 40 minutes, and, with a load in proportion to its power, it is still capable of the highest speeds. Fig. 2 shows the engine as it is running to-day, but it has lately been put to working the daily local passenger trains between Chester and Whitchurch. Its mileage record from November, 1858, to November 30, 1904, is 921,220 miles. It is one of the oldest locomotives now running, and has the largest driving wheels in the world. In this latter connection it may be remarked that with the boiler pressure of 140 pounds to the square inch, the tractive effort of the "Cornwall"

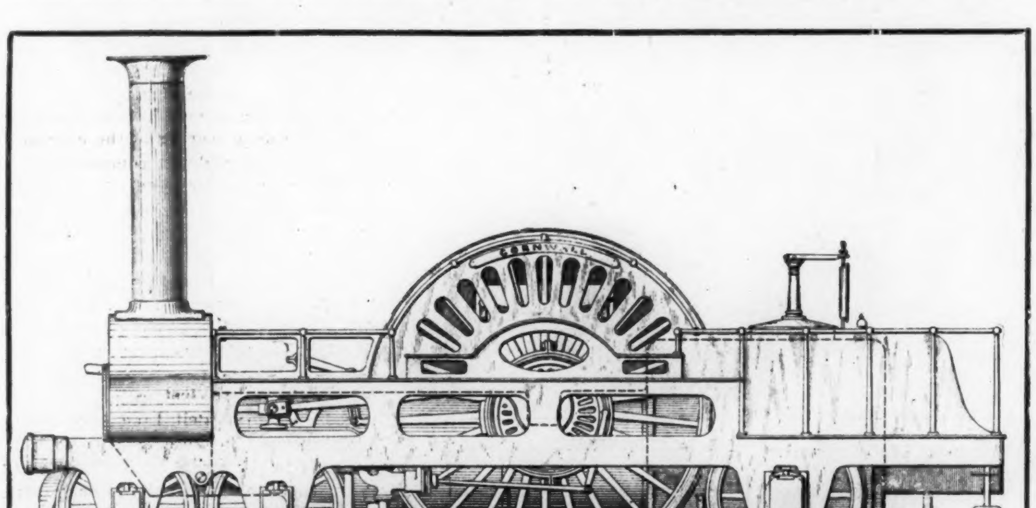


Fig. 1.—London and North-Western Railway Express Engine "Cornwall," 1847.

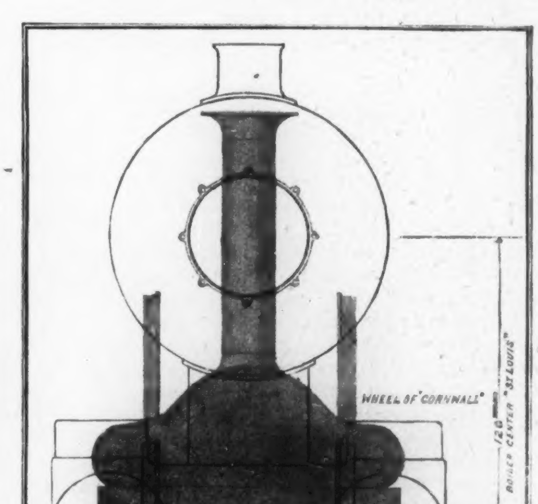


Fig. 3.—Comparative Diagram of the "Cornwall," 1847, and the "St. Louis," 1904.

AN OLD HIGH-SPEED LOCOMOTIVE.

is about 8,575 pounds, which, of course, is low from a modern standpoint, as the big Mallet compound engine "St. Louis" of the Baltimore & Ohio Railroad, which was exhibited at the recent St. Louis Exposition, has a drawbar pull of 80,000 pounds. Furthermore, it is interesting to note that the center line of the boiler of the "Cornwall" in its original form was only 2 feet 8 inches from the rails, while that of the "St. Louis" is no less than 10 feet from the rails—a sweeping refutation of the old low-boiler theory. Indeed, as railway speeds have advanced, locomotive boilers have been raised, and it has been found that engines with high boilers are steadier and easier on the track than those with a low center of gravity. This center of gravity is far lower than was at one time supposed, for in recent years the matter has been practically studied, and by experiments carried on at the Rogers Locomotive Works in 1899 with a 218,000-pound consolidation engine having a boiler center 9 feet 2 inches above the rails, the center of gravity was found to be just in front of the fire-box and only 4 feet 2½ inches from the rails. A prominent engineer at that time calculated that it would need a speed of 132 miles an hour round a 30-chain curve with no superelevation of the outer rail to cause this engine to capsize. We have thus gained the knowledge that in spite of a high boiler barrel (which is relatively light) the weight of the cylinders, frames, connecting rods, etc., keeps the center of gravity low.

Fig. 3 is a graphic illustration of the enormous strides which have been made in locomotive dimensions, the difference of boiler heights of the "Cornwall" and the "St. Louis" being strikingly evident. It will also be noticed that the diameter of the cylinders of the latter engine nearly approaches that of the boiler of Trevithick's engine.

With regard to driving wheels, it may be said that the movement in favor of small wheels (about 5 feet diameter) began in this country, our average speeds being lower and our loads heavier than in England, although our designers have produced some fast engines with comparatively small driving wheels, attaining this result by means of large steam ports, giving a quick valve opening for both steam and exhaust.

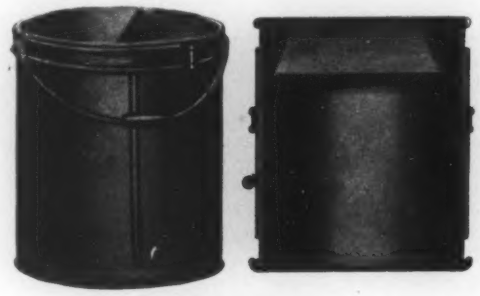
As time went on, speeds were gradually raised but wheel diameters remained practically unchanged, resulting in a loss of efficiency not fully understood until recent years. This branch of locomotive engineering has been practically studied at Purdue University, and Prof. Goss, dean of the schools of engineering at that institution, has kindly given the writer some original information showing that for all locomotives there is a speed point for which the output of power will become maximum, since in the scale of speed, this occurs when the boiler capacity is reached. When the Purdue engine "Schenectady" (No. 1), which has cylinders 17 inches diameter by 24 inches stroke and 56-inch driving wheels, was tested to ascertain its maximum power speed, it was found that the economy attending the cylinder action was highest at a speed of 35 miles an hour, and as the number of revolutions was increased above this speed, the economy of the engine proportionately diminished, the loss of mean effective pressure from the high piston velocity being greater than the gain in speed. This point at which the power no longer increases with the speed is known as the "critical speed" of a locomotive and will of course vary in different engines. In the Purdue engine it is, as we have seen, 35 miles an hour, which is a comparatively low speed —at least for passenger engines.

Since the piston velocity is governed by the diameter of the driving wheels, an engine of given cylinder volume will use more steam per mile with small drivers than with large ones. We can therefore understand how a fast engine may be crippled by having the driving wheels too small for the boiler. This has often occurred in practice, for many of our engines of a few years ago were of the same dimensions as the Purdue locomotive, so that while the drivers of the "Cornwall" are too large for paying train loads, the reaction in favor of small wheels swung to the opposite extreme, until the Purdue experiments led to the advancement of an argument in favor of larger drivers for high speeds—an argument which has found satisfactory response in the practice of recent years, for many of our express engines have now 7-foot driving wheels. In conclusion the writer takes pleasure in thanking Mr. George Whale, chief mechanical engineer of the London and North-Western Railway, for his courtesy in furnishing many interesting particulars of the engine forming the subject of this notice.

The St. Louis Republic says the inventor of to-day is no longer invested with the pathos of unrequited patience, but is the man of all others who leaps to eminence and fortune.

A NOVEL MILK PAIL.

The milk pail which is pictured in the accompanying engraving is provided, in addition to the receptacle for milk, with a compartment for carrying a sponge and a chamber for water to be used in washing the cow's udder before milking so that the milk will be kept clean. According to the arrangement the pail is made reversible, being in one position adapted to carry water and in the reverse position to receive milk. In our illustration the pail is shown with the milk receptacle inverted and the water and sponge compartments at the top. A transverse wall separates these compartments from the milk receptacle, and an inclined wall separates the water compartment from the sponge-holder. This inclined wall, it will be observed, forms a contracted mouth for the sponge compartment, so that the sponge will be retained while the pail is carried in reverse position. A ring or band encircles the body of the pail and is prevented from slipping off by the crimped edges of the pail. To this band the bail is hinged. On the body of the pail two ribs are formed which prevent the band from dropping down to the lower end. However, two offsets are formed on the band so that when the pail is reversed they may be brought into register with the ribs and the band may be raised, bringing the bail in position for use. Our section view is taken through the ribs and shows the bail being raised after the pail has been reversed. When raised to the top, the band is given a half turn to prevent it from slipping down again. A suitable cover closes the mouth of the milk receptacle and prevents entrance of dirt when the pail is set on the ground in an inverted position. It also serves as a protection when carrying the milk. Mr. Fred W. Lechner, of Winona, Ill. (R.F.D. No. 11) is the inventor of this novel milk pail.



A NOVEL MILK PAIL.

AN ICELESS ELECTRIC REFRIGERATOR ON A SMALL SCALE.

BY GEORGE J. JONES.

Ever since the perfection of the cold storage plant money and brains have been expended in producing an iceless refrigerator. It was generally conceded that there was a demand on the part of dairymen, soda fountain proprietors, saloon keepers, butchers, and grocerymen for something that would make them independent of the iceman, and this seems at last to have been accomplished. Besides being a great convenience, the new refrigerator has a number of other recommendations, notably its cleanliness. Because of the great amount of moisture in the interior of the refrigerator, and because of the material usually stored within, the walls tend to become foul unless cleaned with scrupulous care at frequent intervals. This condition is brought about all the more quickly where the ice is not pure. Moreover, the charging of the ice receptacle every day is a nuisance. All this is done away with by means of electric refrigeration.

ARTIFICIAL REFRIGERATION ON A SMALL SCALE.

The electric refrigerator is a self-contained and automatic cold storage plant in a small way. It almost takes care of itself. The switch controlling the electric current is the only part that must be manipulated.

A refrigerator of this kind has been in operation for some time as an experiment in a Philadelphia grocery store. When the store is opened in the morning, the current is turned on and remains so during the day. Although the box is being constantly opened and closed, the temperature is maintained at 34 degrees. About the best temperature obtainable by the ordinary method of icing is 40 to 42 degrees. When the store is closed for the night the current is shut off, and the temperature remains almost constant all night. The difference shown by the mercury between the closing and opening hours is never more than one degree. During all this time no operating expenses whatever have been incurred.

The largest soda fountain in Philadelphia has been in operation for several months, and the materials drawn therefrom have been uniformly several degrees colder than could be secured with the use of shaved ice, and yet no ice has been used in it. A motor of one-half horse-power in the cellar operates a refrigerating plant, which not only keeps the fountain at a frigid temperature, but also does some additional work of a similar character in the cellar.

The iceless refrigerator is much the same in appearance as any large refrigerator. In a compartment at one end a motor and all the necessary compressors and other paraphernalia are contained. The place usually occupied by the ice is given over to a tank containing brine, which is the means of cooling the interior of the refrigerator. The principle is identical with that of the large refrigerating establishments, but this is the first time that the system has been reduced to an automatic basis. No expert knowledge of either electricity or refrigeration is required in order to operate one of these outfits. The types now being manufactured are of the sizes which are likely to be required by storekeepers who would ordinarily make use of at least two hundred pounds of ice daily. The next step will be the manufacture of one which will be available for the larger householder, and will be operated by a motor of one-eighth horse-power.

Another notable feature of one of these equipments is that where it is desired to have ice for use on the table, these machines will make it while performing their ordinary functions. One of the refrigerators has facilities for making two ten-pound pieces of ice per day, and another with a little different arrangement will make a number of small cubes.

A 10,000 Horse-Power Parsons Turbine.

Two steam turbine sets of 10,000 horse-power each, which are being installed at the Rhenanian Westphalian electricity works, are the largest turbine sets, and in fact the largest stationary engines of all Europe. Each of these gigantic engines comprises a turbine running at 1,000 r. p. m., which is direct-connected to a rotary current generator of 5,000 kilowatts, 5,000 volts, and 50 periods per second, as well as to a direct-current generator of 1,500 kilowatts and 600 volts, and to a central condensing plant. The whole set is 20 meters in length, and weighs 190 tons, of which 9.4 meters and 107 tons correspond to the turbine. The maximum height of the turbine above the floor is 2.6 meters, and the maximum breadth likewise 2.6 meters. The turbine is of the single-cylinder type, and has only two bearings, one of which serves at the same time as a bearing to the alternator. The governor is made to compensate to 1 per cent for any oscillations in the angular speed, with variations in the load as high as 20 per cent, while the maximum variation in the number of revolutions between running at no load and at full load is not to exceed 5 per cent. Another unit of the same size is shortly to be installed at the power station in a Westphalian mining company.

The Heaviest Rails.

The rails on the Belt Line Road around Philadelphia are the heaviest rails used on any railroad in the world. They weigh 142 pounds to the yard, and are 17 pounds heavier than any rails ever used before. They are ballasted in concrete, and 9-inch girders were used to bind them. All the curves and spurs were made of the same heavy rails, and the tracks are considered superior to any railroad section ever undertaken. The rails were made especially for the Pennsylvania Railroad by the Pennsylvania Steel Company. An officer of the railroad company states that this section of roadbed will last for twenty-five years without repairs.—International Railway Journal.

RECENTLY PATENTED INVENTIONS.

Electrical Devices.

MICROPHONE.—P. J. TARIEL, 19 Rue Kléber, Issy-les-Moulineaux, Seine, France. The invention relates to a microphone the particles of carbon of which are in the form of pellicles or films, thereby greatly increasing the sensitiveness of the apparatus. These are obtained by taking plates of coal of about from one-tenth and a half to two-tenths of a millimeter thick which are perfectly plane and smooth and which are then broken between the fingers. The so-obtained pellicles are passed through a special sieve in order that those of more than one millimeter of surface will remain in the sieve. Those are the only ones used. The use of these pellicles has very important technical advantages.

Of Interest to Farmers.

CHECK-CONTROLLED MEASURING DEVICE.—J. KIES, Gregor, Wis. The principal object of this invention is to provide means for measuring liquids so controlled by a check that upon placing a check of the desired size in the machine a certain number of pails or other measures of liquid may be drawn and that the machine may then be locked, so that no more can be drawn until it is unlocked by the insertion of another check. Checks may be made of different sizes for setting the machine to draw different numbers of measures of liquid. It is especially designed for the purpose of checking off milk.

STUMP-BURNER.—C. N. HUBBARD, Bee, Wash. The inventor has for his object the simplification of construction, reduction in cost, and increase in efficiency of operation. A further object is to provide a stump-burner by means of which a stump can be burned near other combustible objects without injuring the same even on a windy day.

Of General Interest.

SIGHT-SETTING DEVICE.—G. E. HUMBERT, New York, N. Y. In the present patent the improvement has reference to sights for rifles and other fire-arms; and the inventor's object is the provision of a new and improved sight-setting device arranged to enable the marksman to conveniently and accurately set the sight to exact range for fine shooting.

POCKET-TRANSIT.—W. D. VERSCHOYLE, Seattle, Wash. The device is for use by prospectors, mariners, and others. The horizontal magnetic bearing is quickly ascertained and also the vertical angle lying vertically between the line joining the horizon to the observer's eye and the line intersecting the observer's eye from a point above or below the horizon, both of the horizontal and vertical angles being observed and read at once in one operation and with great accuracy. To do this work generally requires two instruments, a prismatic compass and an Abney level, or with a Brunton transit it takes twice the time with lessening of accuracy.

COLLAR-BUTTON FASTENER.—B. Z. SMITH, Mountainhome, Idaho. In this case the button proper is provided with a hinged member adapted to be adjusted parallel to the button back or in line with the shank thereof, the latter position being necessary when the button is being attached to and detached from the garment. The fastener is adapted to be very easily inserted through several thicknesses of cloth as required in some instances.

FOLDING BIT-BRACE.—C. W. STITES, New York, N. Y. The object of the improvement is to provide details of construction for a bit-holding brace, such as used by woodworkers, which enable the body of the brace to be folded into a compact package and be quickly arranged for use when this is desired, a further object being to so construct the parts forming the brace that it will be very light, strong at the bends in the same, be adapted for a reliable connection of the members thereof where parts are hinged together, and as an entirety provide a neat, shapely device.

COMBINED OIL-CAN AND FUNNEL.—A. R. SEAVY, Riceville, Iowa. This funnel attachment for an oil-can is normally carried upon the body of the can near the spout and adapted for removal and reversal in position on the can, thus affording a capacious funnel disposed above and concentric with the can-opening, so that the oil may be freely poured into the can-body through the funnel and avoid loss of any oil, and, further, afford a drip-catching cup at the base of the can spout which will arrest overflow or drip that may run down the spout.

COLLAR.—B. B. LAWRENCE, New York, N. Y. The purpose of the inventor is to provide a construction of turn-down collars which will admit of the free movement of a band-tie when placed in position on the collar for tying and adjustment, the tie having practically the same freedom of movement upon a turn-down as upon a standing collar. He also provides means for ventilation, and for preventing suction where the tie passes between opposing faces of the members of the collar.

BUTT-JOINT.—F. C. KELSEY, Salt Lake City, Utah. This invention is a butt or end joint for strips or staves in pipe made of wooden staves bound together for conveying water and other liquids under pressure. The strips or staves are made in various lengths and the pipe is put together so that the end joints are broken and do not come opposite each other. The special advantages claimed are that it makes a stronger and tighter pipe. It is also easier to construct the pipe with this joint, as it guides the ends of the staves into position and holds them as the pipe is constructed.

DETACHABLE FILM-SPOOL RECEPTACLE FOR PLATE-HOLDERS.—E. L. HALL, New York, N. Y. One purpose of the invention is the provision of a novel form of plate-holder for cameras and a film-spool receptacle for such holders, whereby a film can be used in connection with a plate-holder, which holder can be used the same as an ordinary holder, enabling focusing to be accomplished through the ground glass of the camera-box.

REDUCING-VALVE.—G. M. HILGER, Chicago, Ill. In the present patent the invention has for its object the provision of a new and improved reducing-valve which is simple and durable in construction, very effective and sensitive in operation, and arranged to prevent any jerking or jarring of the valve when it is in use.

BREAST-PUMP.—H. H. HALSTEAD, Poughkeepsie, N. Y. One purpose of this case is to provide a pump capable of being conveniently applied and operated by the person to whom the application is made and which will cling tenaciously to the breast during the drawing of the milk, but which may be almost instantly released, and, furthermore, an air-exhausting device which will not have a tendency to make the breast sore.

HOOK-HANGER.—J. L. CAVANAUGH, Canton, Ohio. The hanger is readily manipulated so as to hang a sign or card or remove it. It comprises an elongated body with extremities formed into hooks, a keeper-hook pivotally attached to the body near the upper part and uniting to form a threaded neck. A nut is mounted on the neck, a second keeper-hook is pivotally attached to the said body near the lower portion, and a collar is slidably mounted on the lower portion of the said body, to lock the second keeper-hook, the keeper-hooks uniting with the first hooks to form closed eyes.

HOISTING-WINDLASS.—A. CHUBB, JR., La Crosse, Wis. The simple construction of this device adapts it for use in various connections where a temporary hoisting apparatus must be quickly set up. While usable in connection with the raising of a coupler to its position, it could be as useful in connection with the removal of car-bolsters or any similar fittings at other points. Furthermore, it should have a wide usefulness by riggers and other handicraftsmen in order to carry out its general purpose.

DOOR-WICKET.—S. T. CORBITT, Enid, Oklahoma. Means are provided by this inventor whereby a person within a room or house may observe people and things outside the door without opening the door; and the principal object of the invention is to provide for giving a very wide range of vision without making a large opening through which the interior of the room or building can be seen from without.

LUMBER-LABEL.—A. E. BAIRD, Nashville, Tenn. Mr. Baird's invention relates to descriptive labels to be attached to lumber piles, staves, shooks, and the like, in which it is necessary to show on the label various data with respect to the kind, quality, etc., of the lumber and to permit of readily changing these features so as to show varying amounts of material remaining in the pile. This label-holder can be instantly and firmly attached to any pile, without any nailing operation, and is a plainly-visible label thoroughly protected from rain and kindred influences and one upon which the data can be changed with ease and rapidity.

TOILET INSTRUMENT.—C. C. HARRIS, Orange, Mass. The instrument is of neat and compact form adapted to be carried in one's pocket and useful for the purpose of extracting substances from one's flesh. With the device a manicuring instrument is incorporated, the point of which is protected by surrounding parts, and it includes members especially adapted for removing deposits from the pores of the skin.

AUTOMATIC ASH-DUMP.—C. DORFFEL, Seattle, Wash. Mr. Dorffel's invention is in the nature of a device to be placed in an opening in the hearth of a fireplace or in the floor beneath the ash-pit of a stove, which device while closing the opening against upward draft of air will when it receives a definite charge of ashes and cinders from the grate or stove above automatically transfer the same to the cellar below the hearth or into a chute and subjacent receptacle outside of the house.

TIN PACKING FOR MILK, CREAM, OR THE LIKE.—N. F. H. DREYER, Aarhus, Jutland, Denmark. The tin packings are so constructed that the usual air-space inside the tin packing is avoided. By pasteurising milk or cream in the tins, and subsequent soldering of the lid the cooling and corresponding contraction of the liquid forms an air space between the lid and liquid. When such a tin is opened after a railway journey or other shaking conveyance, a part of the cream is transformed to butter. In order to do this the invention avoids the air space.

FOUNTAIN-PEN.—D. F. GALLAGHER, New York, N. Y. In the present patent the object of the inventor is to provide a new and improved fountain-pen which is simple and durable in construction, cheap to manufacture, and easily and conveniently filled whenever required without disconnecting the parts or soiling the user's hands.

Heating and Lighting.

GENERATING OIL-BURNER.—P. S. SPILLER, Austin, Texas. In the present invention the improvement has reference to apparatus by which steam is generated and petroleum or a hydrocarbon reduced to vaporous condition and mixed or combined with the steam and in highly-heated condition burned for heating, lighting, or other purposes in the arts.

Household Utilities.

MATTRESS FRAME OR SUPPORT.—A. MARDIS, Sylvia, Kan. The object in the present invention is the provision of a new and improved mattress frame or support for convenient attachment to an iron or wooden bedstead and arranged to allow taking up all slack in the mattress to give the desired tension to the wires.

WINDOW-SHADE.—M. L. HANSEN, San Francisco, Cal. The invention relates to means for screening the transparent glazing of a window from sunlight, and also to protect the window from felonious entrance, and the object is to provide a simple and conveniently operated device, so as to adapt the shade to screen more or less of the window, be secured at any point of adjustment for the screen, or be elevated so as to permit sunlight to enter the lower half of the window-sash, a further object being to provide a shade, strong, of ornamental form, fireproof, and that will freely admit air if open and at the same time prevent entrance of a burglar.

WARMER FOR DISHES OR THE LIKE.—N. F. BONIFACE, New York, N. Y. The object of this invention which relates to kitchen and table articles is to provide a new and improved warmer for dishes and the like which is simple and durable in construction and arranged to contain and burn the fuel with a view to warm the dishes or like articles and keep the same warm for a long time without requiring recharging of the warmer with fuel.

Machines and Mechanical Devices.

BRICK-MACHINE.—H. B. FISHER, New Orleans, La. The invention pertains to improvements in machines for forming brick of concrete, the object being to provide, in connection with a mold, a simple means for giving a polished or smooth surface to the face of the brick. Another object is to provide means for removing the formed wet brick from the mold without danger of breaking or defacing the brick.

CONTROLLING MECHANISM.—F. B. ESTES, Boise, Idaho. In this instance the improvement relates to controlling mechanisms, and particularly to those adapted for regulating the power supplied by windmills to such apparatus as pumps. Its principal objects are to provide means for maintaining a substantially constant output of the driven apparatus irrespective of the speed of rotation of the windmill.

DRIER AND SEPARATOR.—J. WATERHOUSE, New York, N. Y. The invention relates to improvements in machines for drying sand, detritus, or earthy matter containing precious metals or gem stones; and the object is to provide a machine that shall be simple in construction and rapid and effective in operation by the use of dry air for absorbing and carrying away the moisture and when sufficiently dry carrying away the sand and dust contained in the material operated on.

POWER-TRANSMITTING SYSTEM.—A. N. OLSON, Cambridge, Minn. The objects of this inventor are to provide a system to take the place of spur and bevel gears in automobiles and all kinds of machinery. Further objects are to provide means for reversing and changing speed, and to do away with a large amount of friction on the journals, and to provide for the easy and efficient operation of devices of this character.

Pertaining to Vehicles.

ROLLER-BEARING.—R. F. BOWER, Lima, Ohio. Mr. Bower's invention is an improvement in roller-bearings, and especially in such bearings designed for use on vehicle-wheels. In operation the end balls, operating in the raceways provided by the grooves, prevent the rollers from getting out of alinement when one roller is smaller than another.

HARNESS ATTACHMENT.—A. S. RUDOLPH, Carmi, Ill. In the present construction of harness the shafts are held by straps which have been wound around them or through which the shafts have to be passed. Either of these operations consumes considerable time in harnessing of horses; and it is the principal object to provide means in this invention for holding shafts so arranged that the shafts can be attached to it by very simple operation, thus avoiding both manipulations mentioned above.

NOTE.—Copies of any of these patents will be furnished by Munn & Co. for ten cents each. Please state the name of the patentee, title of the invention, and date of the paper.

Business and Personal Wants.

READ THIS COLUMN CAREFULLY.—You will find inquiries for certain classes of articles numbered in consecutive order. If you manufacture these goods write us at once and we will send you the name and address of the party desiring the information. **In every case it is necessary to give the number of the inquiry.**

MUNN & CO.

Inquiry No. 6905.—For manufacturers of cocoanut oil and copra from the cocoanut.

Inquiry No. 6906.—For firms making small castings, such as used on step ladders and coffee mills.

Inquiry No. 6907.—Wanted, machines for cutting butter in 56-pound boxes into one-pound blocks.

Inquiry No. 6908.—For parties manufacturing refrigeration machinery for small plant to cool about 30,000 cubic feet, for butter, eggs and cheese.

Inquiry No. 6909.—For makers of twisted wire, or other display racks, on which to display bottles on counters.

Inquiry No. 6910.—For manufacturers of alum.

Inquiry No. 6911.—Wanted, German silver drawn in rods about No. 14 wire gage.

Inquiry No. 6912.—Wanted, small camel hair brushes, of cheap grade, mounted in quills.

WANTED.—English Linens (coarse weave) 36 to 72 inches wide—suitable for artists' canvas. Linens, Box 773, New York.

Inquiry No. 6913.—For makers of woolen and cotton yarns, also of knitting machinery.

Inquiry No. 6914.—For makers of brick machinery.

Inquiry No. 6915.—For makers of pointing steel wire.

Inquiry No. 6916.—For makers of machinery for manufacturing automatic cold pressing machines.

Inquiry No. 6917.—For makers of wood or paper tubs or pails.

Inquiry No. 6918.—For manufacturers of turbine water wheels.

Inquiry No. 6919.—Wanted, machines for making egg-crate cardboard fillers.

WANTED AT ONCE.—First-class gas engine salesman, one who understands gas engines and all accessories, for city and country business. Address, with references, Fairbanks Co., corner Broome and Elm Streets, New York City.

Inquiry No. 6920.—For makers of soap making machinery.

WANTED.—Party to manufacture and market an inexpensive Motion Picture and Talking machine combined (for home entertainment), on royalty or percentage basis. Or will sell patents, etc., outright. M. L. Swaab, 338 Spruce Street, Philadelphia, Pa.

Inquiry No. 6921.—For makers of electrically-driven rock drills.

WANTED.—The patents or sole agency for Britain and France, of new machines and articles used in the Brewing and Allied Trades. Highest references given and required. State best terms with full particulars to "Wideawake," care of Streets Agency, 30 Cornhill, London, England.

Inquiry No. 6922.—For manufacturers of small turbines or cheap rotary engines operated by steam pressure.

WANTED.—A first-class Machine Shop Foreman: a man who is capable of producing work at the lowest possible cost. Must be a man of ideas and capable of hiring and handling men. Reliability first consideration. Steady position with opportunity to advance. Factory at Waterloo, Iowa. Address Manufacturer, Box 773, New York.

Inquiry No. 6923.—For makers of or dealers in oil cloth, fruit, canned goods, churns, chalk, etc.

Splendid opening for a high-grade mechanical engineer, who has had a broad experience in managing machine shops, the manufacture of machinery, engines and metal specialties. Applicants must be in prime of life and now employed. Preference will be given to applicants who have had modern scientific training in mechanical schools of high standing. Unqualified references will be exacted. All communications received will be regarded as strictly confidential. Address Mechanical Engineer, Box 773, New York.

Inquiry No. 6924.—For a machine or lathe for turning tapered stock for fishing rods.

Inquiry No. 6925.—For makers of or dealers in refrigerating machines.

Inquiry No. 6926.—For manufacturers of candles.

Inquiry No. 6927.—For makers of rotary pumps.

Inquiry No. 6928.—For makers of hand ice machines.

Inquiry No. 6929.—For manufacturers of novelties in general.

Inquiry No. 6930.—For manufacturers of bioscopes and kinetoscopes.

Inquiry No. 6931.—For machines for making soda water, also for making ice.

Inquiry No. 6932.—For makers of unruled linen tablets, called "Old Flax Linen."

Inquiry No. 6933.—For the makers of the "Kriebel" steam engine.

Notes and Queries.

HINTS TO CORRESPONDENTS.

Names and Address must accompany all letters or no attention will be paid thereto. This is for our information and not for publication.

References to former articles or answers should give date of paper and page or number of question.

Inquiries not answered in reasonable time should be repeated; correspondents will bear in mind that some answers require not a little research, and, though we endeavor to reply to all either by letter or in this department, each must take his turn.

Buyers wishing to purchase any article not advertised in our columns will be furnished with addresses of houses manufacturing or carrying the same.

Special Written Information on matters of personal rather than general interest cannot be expected without remuneration.

Scientific American Supplements referred to may be had at the office. Price 10 cents each.

Books referred to promptly supplied on receipt of price.

Minerals sent for examination should be distinctly marked or labeled.

(9648) L. K. asks: Will you kindly tell me through your valuable paper which way the compass points south of the equator—to the north or to the south pole? A. In both hemispheres the magnetic needle points to both poles, except for the declination of the needle. That the north end of a needle should point to the north pole necessitates that at the same instant the south end should point toward the south pole. Along the line of no magnetic declination this is actually the case. The needle points to true north and true south.

(9649) F. B. B. asks: Would you please answer through your columns why any change in the number of magnetic lines of force passing through the spaces inclosed by a coil of wire produces a current of electricity in that wire? A. The reason why a change in the magnetic condition of a space produces a current of electricity in a conductor in the same space, is to be found in the theory of the ether of space. The ether is subject to stresses which produce various effects in vibrations, vortices, and currents. To the vortices are attributed the magnetizing power of the ether; to the difference of potential set up in various ways is due the flow of electricity. A change of magnetic condition has been found to be an occasion of a flow from a point of higher to one of lower potential. This is an electric current. If there is a wire there, it will usually take the wire in its path, otherwise it goes through anything it can break through, as in the case of a stroke of lightning. A change in the magnetic lines of force produces a similar effect in a small way in our apparatus, and thus we have a current of electricity whenever the number of lines of force inclosed by a coil of wire are changed.

(9650) L. A. T. asks: Will genuine amber burn? A. Amber burns with a pale yellow flame, with a good deal of black smoke, evolving an agreeable odor, and leaving a black mass of carbon behind. As it is about 79 per cent carbon, and 10.5 per cent each of hydrogen and oxygen, it is evident that it must be combustible. We should infer the same fact from its origin. Amber is a fossil gum, partly soluble in alcohol and ether; since it frequently contains insects, it must have been a viscid liquid when these were entrapped to their destruction. Imitation amber may be made with the insects in place as in the genuine article, although in the genuine amber the insects are usually of extinct species. 2. Is there any imitation of amber that can be electrified, so that it will pick up bits of paper as amber will? A. Since most gums and resins can be electrified by rubbing, it is probable that imitations of amber may be electrified. 3. Kindly give me an infallible test by which the genuine article can be identified. A. Amber contains nearly 90 per cent of a resin which resists all solvents, called succinite, and 2½ to 6 per cent of succinic acid. There are also two other resins soluble in alcohol and ether, besides an oil. The determination of these by analysis will determine the substance to be amber.

(9651) N. H. asks: Will you kindly answer in Notes and Queries column the following: A doctor uses an X-ray machine when examining patients, and claims to be able to see sore spots and small ulcers on lining of stomach and hepatized spots on lungs, also sores on other internal organs. I have looked through two different X-ray machines, but could only see the bones and flesh. The bones cast a dark shadow, while the flesh cast a lighter shadow. I could not distinguish one organ from another. Which is right? A. We would beg to refer you to the note in the Scientific American of March 11, 1905, page 208, for a partial answer to your inquiry as to the possibility of distinguishing diseased conditions in the interior organs of the body by means of X-rays. We have seen the proof of the correctness of this means of diagnosis, and have the skiagraphs of such conditions in our possession. The lungs, stomach, kidneys, bladder, and liver are susceptible to this mode of examination. Whether the physician you have in mind is sufficiently experienced with these rays to use them for this purpose we do not know. It is certain that a large experience is necessary. We have many times tried to have persons see things on the fluorescent screen which were perfectly plain to us, but which they could not distinguish at all.

(9652) C. K. asks: 1. Is there any method of calibrating volt and ampere meters without the aid of another volt or ammeter? Would the following method answer? Place two 220-volt lamps in series on a 220-volt light circuit, causing a 110-volt drop in each lamp. Connect the voltmeters in shunt with one of the lamps, and add or take off enough resistance from the meter to make it read 110. Place four lamps in series, and shunt the meter with one of them to get 55 volts. A. You can determine several points on the scale of a voltmeter in the manner you describe by the use of lamps in a rough way, but the voltage of the circuit and the voltage of the lamps are neither of them to be relied upon to any great degree of accuracy. If one cannot do better, this way is better than nothing; but in a great city it should be possible to graduate a scale by comparison with that of a reliable instrument. Standard lamps can be had from certain parties which test and guarantee them to be of the rated voltage. 2. Have you any publications that deal with practical measuring instruments? A. We can furnish you Reed's "American Meter Practice" for $2. It is a recent and reliable work on this subject.

(9653) J. W. asks: 1. How is bicycle riding explained? By what laws does a man balance himself? A. A bicycle maintains its upright position upon the same principle that a pendulum maintains its plane of oscillation, or a rotating wheel maintains its plane of rotation. This is most clearly illustrated in the Foucault pendulum and the gyroscope. As long as the bicycle is moving, it will not fall over. 2. Scientists claim to find the shape of the earth by the pendulum. This would all be very well if the density of the earth were the same in all of its parts, but as that is very improbable, it seems to me that the results of these measurements are also very improbable. Is there any way of correcting these results? A. The time of vibration of a pendulum depends upon the intensity of gravity in the place where it is hung and swung. The variation in density of the earth is not great, and the mean density is known to sufficient accuracy. It is not probable that the results of pendulum measurements are greatly in error, or in error at all beyond the variations assigned as the limits of the determination. We have no better way to determine the form of the earth than by the pendulum, and measurements of meridians. 3. In looking over several cyclopedias for the article Parallax, I find that astronomers do not make any allowance for the motion through space of the solar system and of the star whose distance is to be measured. Do they really make any allowance for these motions? These motions certainly influence the parallax. A. The proper motions of some stars are known, and can be allowed for when these stars are observed. This is so little that it cannot affect the parallax to a sensible amount. The nearest star is 4 1-3 light years distant from us. The sun is 8 minutes and 19 seconds from us in terms of the velocity of light. The annual parallax of the nearest star is 75-100 of a second of arc; its distance is 25,000,000,000,000 miles. The variation of its parallax due to the motion of the sun in a year through space is not appreciable. 4. We are bothered here with alkali water. Is there any way of making such water drinkable? A. Without an accurate chemical analysis of your water, it is impossible for us to express any opinion. The question of the purification of drinking water is always a somewhat difficult one, and it seldom happens that impure water can be much improved without considerable trouble and expense. In case you have not tried it, however, we would suggest your boiling the water for a period of about twenty minutes. With some waters this will cause a sediment to form, which when allowed to settle, removes many of the impurities with it.

(9654) J. D. asks: Can you give me in your query department of your paper, data for a small jump-spark coil, such as is used on gasoline motor cycles to explode mixture? Using four dry batteries for the primary excitation. Writer has several pounds of No. 36 B. & S. silk-covered copper wire. Can this be used on secondary? A. A strong and reliable spark can be made for gas ignition with a coil of the following proportions: core length 7 inches, diameter ¾ inch, made of No. 20 iron wire, B. & S. gage. Primary of three layers of No. 14 copper magnet wire, cotton covered. Secondary 1 pound No. 36 silk-covered wire. Condenser of forty sheets of tinfoil, 4 x 6 inches. The insulation of the secondary should be very carefully attended to. Failure here will cause a loss of the whole. The details of the work are given with great fullness in Norrie's "Induction Coils," which we can send you for $1.

(9655) H. J. B. writes: In reading of the applications of electricity in the treatment of disease, I find a statement which seems a little at variance with some others that I have noted. For instance: One, after connecting forty large Columbian dry cells in series (each one giving about 15 amperes), says he was surprised to find an output of 1,600 milliamperes. Now, when the inspector of the telephone comes around, he applies an ampere meter, and from three small cells shows an amperage of 6 or 8 amperes. If I understand the term, a milliampere is 1-1,000 = 0.001 of one ampere. What becomes of all the rest of the electricity, and why do they measure one set of cells with the fractional meter, and the other set with the full measure? As I am a constant reader of your paper, I shall be pleased if you will give me a little more light on this matter. I am thoroughly conversant with the fact that we can seldom take out all that we put into the dish; some will stick to the sides, and there are various ways of loss. But it seems that in this case there must be something that I am a little behind in, and thus I refer to you. In a certain catalogue, I find a description of the Laclede cell or battery, saying "Connected with a faradic coil with milliamperemeter in circuit, it ran the coil 300 hours, giving a 70-milliampere current; on short circuit it gives one ampere; its voltage will average 1.5." A. You are correct in saying that a milliampere is a thousandth of an ampere. Thus 1,660 milliamperes are one and six-tenths amperes. It would be quite as well to express it in that way. But physicians are in the habit of using milliamperemeters, and so fall easily into thinking in the smaller unit. As to the output of cells: The large current can only be realized on short circuit, that is, with no external resistance, and even then a number of cells in series will not give a very large current, or number of amperes. In the case you cite, forty cells in series gave only 1.6 ampere, when one alone will give 15 amperes. The current is cut down to a tenth of the full current of one cell. This is because of the increased resistance in series. Increasing the number of cells in series does not give more current unless there is a large external resistance. With a small external resistance it is better to put the cells in multiple for larger current in amperes. As no data for the various resistances are given in your citations, we cannot present any numerical solution for the different cases, but doubtless this could be done with a full knowledge of the conditions.

(9656) H. J. F. asks: Will you please tell me if a piece of paper 8 inches x 8 inches can be cut so that it will cover a surface containing 65 square inches? Explain if it can be done. A. A piece of paper 8 inches x 8 inches contains exactly 64 square inches of area. By cutting it you cannot make the area any greater. Therefore, by no conceivable means can it be made to cover a surface containing 65 square inches.

(9657) J. G. P. says: 1. I want to put a slide-valve engine about 900 feet from the boilers. The lead pipe to engine is 3 inches. Should this lead pipe be larger? If so, should it be larger all the way, and how much larger should it be? With high-pressure boilers, should the engine have a receiver or separator? A. It will be considerably cheaper to use a 3-inch pipe all the way from the boilers to the engine than to use a larger size; and although there will be a considerable drop probably in pressure between the boiler and the steam chest of the engine, we do not think that this would cause sufficient annoyance to warrant the additional expense of the larger pipe, unless it is desired to have the engine develop the maximum power that it is capable of generating. In the latter case, a 4-inch pipe would be better. A steam separator of liberal size should be placed in the steam pipe close to the engine, but a receiver is not necessary. 2. In putting a crankpin in a large engine, is shrinking the best method? If so, how hot should the disk be heated? How is the best method to heat? Will it hurt the disk, or is there any danger if it gets hot around the main shaft? Could you crack the disk in shrinking the pin in? Should it cool itself, or should there be anything used to cool it? A. Hydraulic pressure is the best means of securing a crankpin in a large engine. If this is not available, the next best plan is to have the crankpin slightly tapered, and then force it into the disk by means of a large nut. It is possible to do this work satisfactorily by shrinkage, but there is some danger of warping the disk slightly by unequal expansion of different parts of the disk. If this method is used, very great care should be taken to heat the disk slowly and uniformly, heating a considerable area on all sides of the crankpin up to a high temperature, but one, of course, very much below a red heat. Care should also be taken to have the cooling as slow and uniform as possible.

(9658) A. L. T. asks: Will you be so kind as to inform me if it is possible or impossible to make a so-called permanent magnet out of a pure soft iron, i.e., a magnet, for example, similar to the steel horseshoe magnets as now made? Can a permanent magnet be made out of any iron? I do not refer to the residual magnetism remaining in the field magnets of a dynamo when not in motion. A. Any iron or steel which has once been magnetized does not again lose all its magnetism, except by heating it red hot. Its magnetism is then destroyed. Good soft iron, cast or wrought, will, however, retain but little magnetism after the magnetizing force is removed. The retentivity to which you allude is the same property in steel as in iron. The field magnets of a dynamo, when of iron, retain little; when of steel, retain more magnetism. A hard steel retains so much that it is called a permanent magnet. It, however, does not retain full magnetic saturation, but loses considerable magnetism very soon after the magnetizing force is removed from it. It is strongest just after it is magnetized. From the above it will be seen that a magnet cannot be made of iron which deserves to be called a permanent magnet.

NEW BOOKS, ETC.

Practical Sanitation. By George Reid, M.D., Ph.D. With an Appendix by Herbert Manley, M. A. Cantab., M.B., Ph.D. Philadelphia: J. B. Lippincott Company, 1904. 8vo.; pp. 351; numerous diagrams. Price $2.

That this handbook on practical sanitation, for sanitary inspectors and others interested in the subject, is of value is shown by the fact that it has reached its eleventh edition. The author is an expert on the subject, and has gone into it in great detail. Among the subjects treated are Water Supply, Drinking Water, Pollution of Water; Ventilation and Warming; Sewerage and Drainage; Sanitary and Insanitary Works and Appliances; Details of Plumbers' Work; Sewage and Refuse Disposal; House Construction; Infection and Disinfection; and Food. The addition of the Acts of Parliament relating to public health in England and Wales is useful as an example of the highest form of sanitary legislation.

Telephone Development. By Vinton A. Sears. Boston: Barta Press, 1905. 8vo.; pp. 121.

The object of this pamphlet, which is now published for the second time, is to encourage the development of the telephone by showing conclusively that better service and lower rates are already being enjoyed under competition. That such service and rates are being furnished to-day on a large scale by telephone companies independent of those operating under the Bell patents, and in successful competition with the latter, besides making attractive earnings at rates which the Bell companies have declared prohibitive, is demonstrated to the satisfaction of all. One of the most interesting facts brought out is that the most important improvements and the most modern high-class apparatus are to-day controlled by independent companies. Telephone conditions in various cities throughout the country, the investigation of the telephone trust, telephone securities and finance, etc., are thoroughly discussed. A map showing the independent telephone toll lines in New York, New Jersey, and Pennsylvania is one of the useful features of this pamphlet.

Calcareous Cements: Their Nature, Manufacture, and Uses, with Some Observations on Cement Testing. By Gilbert R. Redgrave, A.I.C.E., and Charles Spackman, F.C.S. Philadelphia: J. B. Lippincott Company, 1905. 8vo.; pp. 310; 63 illustrations. Price, $2.75.

As the cement industry has been completely changed, and the processes of manufacture used in it have undergone a great revolution in the past ten years, due to the introduction of the rotary-kiln tube mill, as well as other important inventions, the authors of this work, in preparing the second and revised edition, have had to alter it considerably. All the latest processes used in cement manufacture, both here and abroad, are illustrated and described; and all the theories of cement reactions that have been advanced by English and foreign experimenters are given in a chapter on the Analysis of Cement Mixtures. All information of value regarding the cement and concrete industry will be found in this book, which we heartily recommend to all interested in the subject.

An Outline of the Theory of Organic Evolution. With a Description of Some of the Phenomena Which it Explains. By Maynard M. Metcalf, Ph.D. New York: The Macmillan Company, 1904. 8vo.; pp. 204; numerous illustrations. Price, $2.50.

In this book, which is the outcome of a series of lectures given by the author before the students at the Woman's College of Baltimore, the author sets forth briefly the theory of evolution and describes some of the phenomena which it explains, after which he discusses the relation of mankind to evolution. The book serves as an introduction to this great theory, and gives a comprehensive outline of it, together with sufficient illustration to tempt the reader to seek fuller knowledge of the many interesting phenomena relating to it. Although organic evolution seems to be satisfactorily established, there is far from a satisfactory knowledge of the factors which are at work to produce it, and especially are we ignorant of the manner of their operation. The author avoids discussing the more doubtful questions, but merely gives an outline of the apparently well-established facts as to the theory and some of its important corollaries. In the three cases where there is a general difference of opinion upon a fundamental point, namely, regarding the degree of efficiency of natural selection, inheritance of the effects of use and disuse, and evolution and sexual selection, Mr. Metcalf has given the divergent opinions and what seems to him the safest conclusion. The third point mentioned he has illustrated abundantly with pictures, showing some of the phenomena about the explanation of which there is so much difference of opinion. Color in animals is the subdivision of his work to which the author has given the most attention, his reason being that these phenomena might be readily observed by any person in any locality. The first section of the book deals with the theory of evolution, and the second section with the phenomena explained by the theory. The book is illus-

trated with 101 full-page plates, a number of which are in colors, besides some 46 figures. It is printed in large type on fine paper, and will be found a very instructive and entertaining introduction to the study of evolution.

Applications of the Kinetic Theory to Gases, Vapors, Pure Liquids, and the Theory of Solutions. By William Pingry Boynton, Ph.D., Assistant Professor of Physics at the University of Oregon. New York: The Macmillan Company, 1904. 8vo.; pp. 280. Price, $1.60.

The kinetic theory, which may be regarded as a special or specialized theory of heat, is most thoroughly discussed in the present volume. While any adequate treatment of this theory must be mathematical, and while the majority of such discussions are extremely so, the theory itself is of interest specially from the fact that it is fundamentally a physical one that attempts to present to the imagination the mechanism by which things take place. As the kinetic theory is a physical theory, it has to face not only the problems of the gaseous state, but also of the liquid and solid states, and of mixtures and solutions as well as of pure substances. It is, therefore, desirable to present a treatment of as large a scope as possible, and this the author has attempted to do, and has succeeded very well. The book contains all the latest information regarding the kinetic theory, and will be found valuable to students and others interested in the same.

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AND EACH BEARING THAT DATE

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Lamp hood, incandescent electric, D. M. Gilbert ... 37,450
Stove, F. Fieberger ... 37,451

LABELS.

"American Prince," for baking powder, H. Hunter ... 12,167
"Breakfast Cocoa," for cocoa, F. Bischoff ... 12,160
"Buster Brown," for confectionery, Homestead Confection Co. ... 12,166
"Christy Hoe Safety Razor," for safety razors, R. J. Christy Co. ... 12,180
"Clipper Hanger," for clipper hangers, Clipper Mfg. Co. ... 12,183
"Fancy Ceylon," for tea, Wilmanns Bros. Co. ... 12,161
"Harrington Wearproof Sole," for soles, Harrington & Co. ... 12,174
"Hoffman's Hair Tonic," for hair tonic and antiseptic dandruff cure, R. H. Hoffman ... 12,173
"Home Run," for cigars, H. F. Kohler ... 12,165
"Jerry Murphy," for whisky, Fessler & Dunkelberger ... 12,164
"Kownfit," for toilet paper, Scott Paper Co. ... 12,182
"On Sale," for beer, Meyercord Co. ... 12,163
"Paragon," for beer, Wilmanns Bros. Co. ... 12,162
"Phospho Sumbul Comp." for medicine, Lenox Chemical Co. ... 12,169
"Prophylactic Tooth Brush," for tooth brushes, Florence Mfg. Co. ... 12,179
"Re-Vital, A Head Cooler," for medicine, M. E. Waite ... 12,170
"Ruberoid Brown Roofing," for roofing, Standard Paint Co. ... 12,185
"Sa (Not Tear) E E Safe-T-Lu-Pin," for looped pins, E. M. Silberman ... 12,181
"Save the Baby," for croup specific, W. W. Lee ... 12,168
"Snowhite," for bluing, C. M. Hatcher ... 12,177
"Summa Silk," for light silks, Friedman & Johnstone ... 12,176
"The H. & O. Comfort Shaving Cream," for shaving cream, E. C. Hanford ... 12,172
"The 'Keepclean' Tooth Brush," for tooth brushes, Florence Mfg. Co. ... 12,178
"The Mogul Clip," for clips, Clipper Mfg. Co. ... 12,184
"Trostel's Tested Leather," for leather, A. Trostel & Sons ... 12,175
"Webster Springs Salt Sulphur Water," for mineral water, J. T. McGraw ... 12,159
"X-o Remedy," for a proprietary remedy, A. Crichton ... 12,171

PRINTS.

"Fan Base Ball Score Card," for score cards, T. I. Schultz ... 1,333
"Mother and Child," for tonic vermifuge, Dr. D. Jayne & Son ... 1,332
"On Sale," for beer, Meyercord Co. ... 1,331
"The Wheel of Progress," for automobiles J. F. H. Fechtenburg ... 1,335
"Village Blacksmith back, Congress Playing Cards," for playing cards, United States Playing Card Co. ... 1,334

A printed copy of the specification and drawing of any patent in the foregoing list, or any patent in print issued since 1863, will be furnished from this office for 10 cents, provided the name and number of the patent desired and the date be given. Address Munn & Co., 361 Broadway, New York.

Canadian patents may now be obtained by the inventors for any of the inventions named in the foregoing list. For terms and further particulars address Munn & Co., 361 Broadway, New York.

SEALED PROPOSALS will be received at the office of the Light-House Engineer, Tompkinsville, N. Y., until 12 o'clock M., June 21, 1905, and then opened, for furnishing miscellaneous articles for the Light-House Establishment, for the fiscal year ending June 30, 1906, in accordance with specifications, copies of which, with blank proposals and other information, may be had upon application to Lieut.-Col. W. T. Rossell, Corps of Engineers, U. S. A., Engineer.